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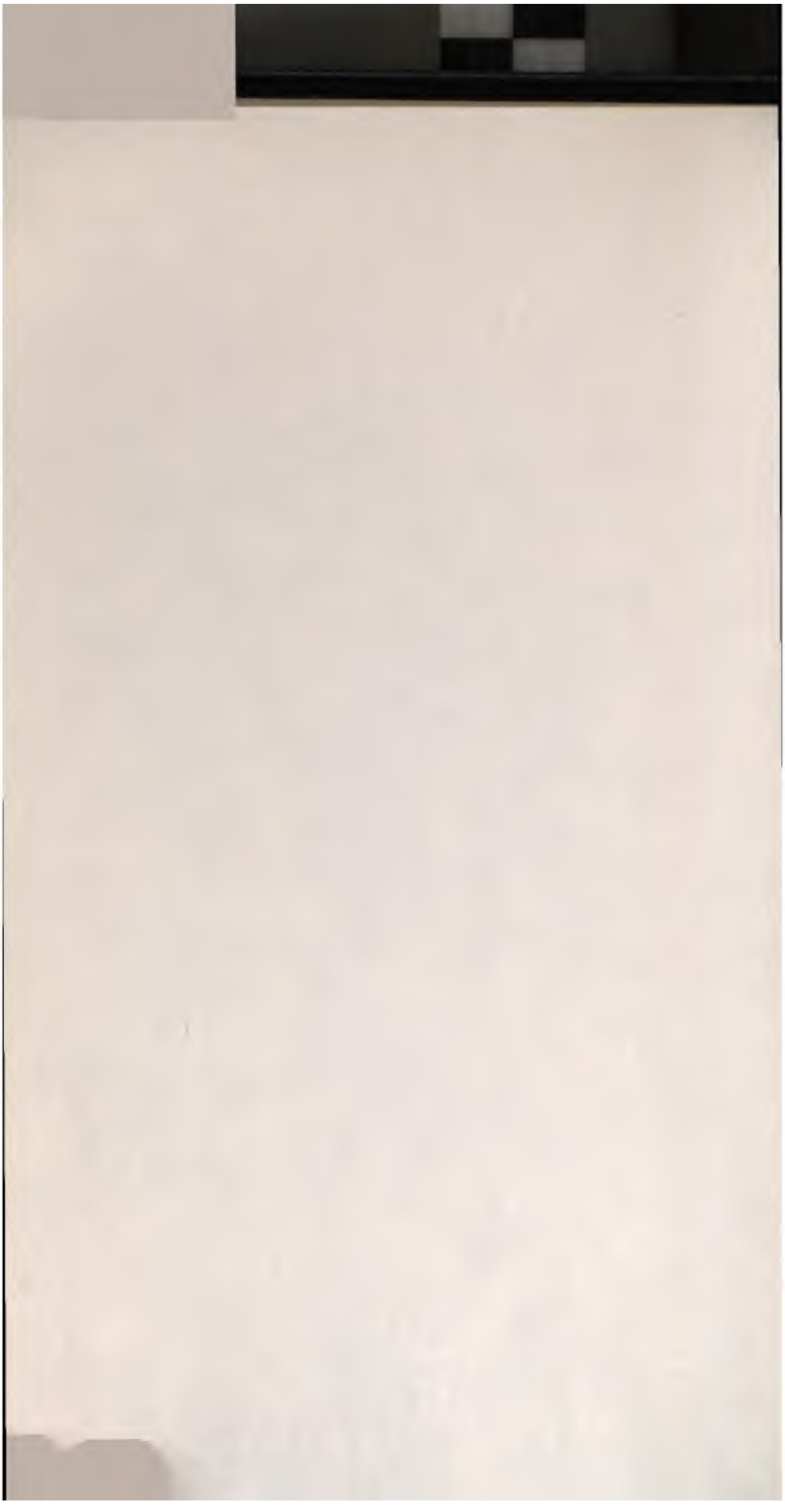

THE MODERN RAILROAD

READY FOR THE DAY'S RUN

THE MODERN RAILROAD

BY

EDWARD HUNGERFORD

AUTHOR OF "LITTLE CORKY," "THE MAN WHO STOLE A RAILROAD," ETC.

WITH MANY ILLUSTRATIONS
FROM PHOTOGRAPHS

FIFTH EDITION

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TO MY FATHER

IN RECOGNITION OF HIS
INTEREST AND APPRECIATION
THIS BOOK
IS DEDICATED

PREFACE

TO bring to the great lay mind some slight idea of the intricacy and the involved detail of railroad operation is the purpose of this book. Of the intricacies and involved details of railroad finance and railroad politics; of the quarrels between the railroads, the organizations of their employees, the governmental commissions, or the shippers, it says little or nothing. These difficult and pertinent questions have been and still are being competently discussed by other writers.

The author wishes to acknowledge the courtesy of the editors and publishers of *Harper's Monthly, Harper's Weekly, The Saturday Evening Post,* and *Outing* in permitting the introduction into this work of portions or entire articles which he has written for them in the past. He would also feel remiss if he did not publish his sincere acknowledgments to "The American Railway," a compilation from *Scribner's Magazine,* published in 1887, Mr. Logan G. McPherson's "The Workings of the Railroad," Mr. C. F. Carter's "When Railroads Were New," and Mr. Frank H. Spearman's "The Strategy of Great Railroads." Out of a sizable reference library of railroad works, these volumes were the most helpful to him in the preparation of certain chapters of this book.

E. H.

BROOKLYN, NEW YORK,
August 1, 1911.

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The railroad is a monster. His feet are dipped into the navigable seas, and his many arms reach into the uplands. His fingers clutch the treasures of the hills — coal, iron, timber — all the wealth of Mother Earth. His busy hands touch the broad prairies of corn, wheat, fruits — the yearly produce of the land. With ceaseless activity he brings the raw material that it may be made into the finished. He centralizes industry. He fills the ships that sail the seas. He brings the remote town in quick touch with the busy city. He stimulates life. He makes life.

His arms stretch through the towns and over the land. His steel muscles reach across great rivers and deep valleys, his tireless hands have long since burrowed their way through God's eternal hills. He is here, there, everywhere. His great life is part and parcel of the great life of the nation.

He reaches an arm into an unknown country, and it is known! Great tracts of land that were untraversed become farms; hillsides yield up their mineral treasure; a busy town springs into life where there was no habitation of man a little time before, and the town becomes a city. Commerce is born. The railroad bids death and stagnation begone. It creates. It reaches forth with its life, and life is born.

The railroad is life itself!

THE MODERN RAILROAD

CHAPTER I

THE RAILROADS AND THEIR BEGINNINGS

TWO GREAT GROUPS OF RAILROADS; EAST TO WEST, AND NORTH TO SOUTH — SOME OF THE GIANT ROADS — CANALS — DEVELOPMENT OF THE COUNTRY'S NATURAL RESOURCES — RAILROAD PROJECTS — LOCOMOTIVES IMPORTED — FIRST LOCOMOTIVE OF AMERICAN MANUFACTURE — OPPOSITION OF CANAL-OWNERS TO RAILROADS — DEVELOPMENT OF PENNSYLVANIA'S ANTHRACITE MINES — THE MERGING OF SMALL LINES INTO SYSTEMS.

FIFTEEN or twenty great railroad systems are the overland carriers of the United States. Measured by corporations, known by a vast variety of differing names, there are many, many more than these. But this great number is reduced, through common ownership or through a common purpose in operation, to less than a score of transportation organisms, each with its own field, its own purposes, and its own ambitions.

The greater number of these railroads reach from east to west, and so follow the natural lines of traffic within the country. Two or three systems — such as the Illinois Central and the Delaware & Hudson — run at variance with this natural trend, and may be classed as cross-country routes. A few properties have no long-reaching routes, but derive their incomes from the transportation business of a comparatively small exclusive territory, as the Boston & Maine in Northern New England, the New Haven in Southern New England, both of them recently brought under a more or less direct single control, and the Long Island. Still other properties find their greatest revenue in bring-

ing anthracite coal from the Pennsylvania mountains to the seaboard, and among these are the Lackawanna, the Lehigh Valley, the Central Railroad of New Jersey, and the Philadelphia & Reading systems.

The very great railroads of America are the east and west lines. These break themselves quite naturally into two divisions — one group east of the Mississippi River, the other west of that stream. The easterly group aim to find an eastern terminal in and about New York. Their western arms reach Chicago and St. Louis, where the other group of transcontinentals begin.

Giants among these eastern roads are the Pennsylvania and the New York Central. Of lesser size, but still ranking as great railroads within this territory are the Chesapeake & Ohio, the Baltimore & Ohio, and the Erie. Several of the anthracite roads enjoy through connections to Chicago and St. Louis, breaking at Buffalo as an interchange point, about half way between New York and Chicago. There are important roads in the South, reaching between Gulf points and New York and taking care of the traffic of the centres of the section, now rapidly increasing its industrial importance.

The western group of transcontinental routes are the giants in point of mileage. The eastern roads, serving a closely-built country, carry an almost incredible tonnage; but the long, gaunt western lines are reaching into a country that has its to-morrow still ahead. Of these, the so-called Harriman lines — the Southern Pacific and the Union Pacific — occupy the centre of the country, and reach from the Mississippi to the Pacific. The Santa Fe and the Gould roads share this territory.

To the north of the Harriman lines, J. J. Hill has his wonderful group of railroads, the Burlington, the Great Northern, and the Northern Pacific, together reaching from Chicago to the north Pacific coast. Still farther north Canada has her own transcontinental in the Canadian Pacific Railway, another approaching completion in

he Grand Trunk Pacific Railway. The "Grangers" (so called from their original purpose as grain carriers), hat occupy the eastern end of this western territory,— the St. Paul, the Gould lines, the Northwestern and the Rock Island — are just now showing pertinent interest in reaching the Pacific, with its great Oriental trade in its infancy. The first two of these have already laid their rails over the great slopes of the Rocky Mountains and so it is that the building of railroads in the United States is nowhere near a closed book at the present time.

The better to understand the causes that went to the making of these great systems, it may be well to go back into the past, to examine the eighty years that the railroad has been in the making. These busy years are illuminating. They tell with precise accuracy the development of American transportation. Yet, as we can devote to them only a few brief pages, our review of them must be cursory.

When the Revolution was completed and the United States of America firmly established as a nation, the people began to give earnest attention to internal improvement and development. Under the control of a distant and unsympathetic nation there had been very little encouragement for development; but with an independent nation all was very different. The United States began vaguely to realize their vast inherent wealth. How to develop that wealth was the surpassing problem. It became evident from the first that it must depend almost wholly on transportation facilities. To appreciate the dimensions of this problem it must be understood that at the beginning of the last century a barrel of flour was worth five dollars at Baltimore. It cost four dollars to transport it to that seaport from Wheeling; so it follows, that flour must be sold at Wheeling at one dollar a barrel for the Baltimore market. With a better form of transportation it would cost a dollar a barrel to carry the flour from Wheeling to Baltimore, making the price

of the commodity at the first of these points under transit facilities four dollars a barrel. It did not take much of that sort of reasoning to make the States appreciate from the very first that a great effort must be made toward development. That effort, having been made, brought its own reward.

The very first efforts toward transportation development lay in the canal works. Canals had already proved their success in England and within Continental Europe, and their introduction into the United States established their value from the beginning. Some of the earliest of these were built in New England before the Revolution. After the close of that conflict many others were planned and built. The great enterprise of the State of New York in planning and building the Erie, or Grand Canal, as it was at first called, from Albany to Buffalo — from Atlantic tidewater to the navigable Great Lakes was a tremendous stimulus to similar enterprises along the entire seaboard. Canals were built for many hundreds of miles, and in nearly every case they proved their worth at the outset. Canals were also projected for many, many hundreds of additional miles, for the success of the earliest of these ditches was a great encouragement to other investments of the sort, even where there existed far less necessity for their construction. Then there was a halt to canal-building for a little time.

The invention of the steamboat just a century ago was an incentive indirectly to canal growth but there were other things that halted the minds of farsighted and conservative men. Canals were fearfully expensive things; likewise, they were delicate works, in need of constant and expensive repairs to keep them in order. Moreover, there were many winter months in which they were frozen and useless. It was quite clear to these farsighted men from the outset that the canal was not the real solution of the transportation problem upon which rested *the* internal development of the United States.

They turned their attention to roads. But, while roads were comparatively easy to maintain and were possible routes of communication the entire year round, they could not begin to compare with the canals in point of tonnage capacity, because of the limitations of the drawing power of animals. Some visionary souls experimented with sail wagons, but of course with no practical results.

At this time there came distinct rumors from across the sea of a new transportation method in England — the railroad. The English railroads were crude affairs built to handle the products of the collieries in the northeast corner of the country, to bring the coal down to the docks. But there came more rumors — of a young engineer, one Stephenson, who had perfected some sort of a steam wagon that would run on rails — a locomotive he called it,— and there was to be one of these railroads built from Stockton to Darlington to carry passengers and also freight. These reports were of vast interest to the earnest men who were trying to solve this perplexing problem of internal transportation. Some of them, who owned collieries up in the northeastern portion of Pennsylvania and who were concerned with the proposition of getting their product to tidewater, were particularly interested. These gentlemen were called the Delaware & Hudson Company, and they had already accomplished much in building a hundred miles of canal from Honesdale, an interior town, across a mountainous land to Kingston on the navigable Hudson River. But the canal, considered a monumental work in its day, solved only a part of the problem. There still remained the stiff ridge of the Moosic Mountain that no canal work might ever possibly climb.

To the Delaware & Hudson Company, then, the railroad proposition was of absorbing interest, of sufficient interest to warrant it in sending Horatio Allen, one of the canal engineers, all the way to England for investigation and report. Allen was filled with the enthusiasm of

youth. He went prepared to look into a new era in transportation.

In the meantime other railroad projects were also under way in the country, short and crude affairs though they were. As early as 1807 Silas Whitney built a short line on Beacon Hill, Boston, which is accredited as being the first American railroad. It was a simple affair with an inclined plane which was used to handle brick; and it is said that it was preceded twelve years by an even more crude tramway, built for the same purpose. Another early short length of railroad was built by Thomas Leiper at his quarry in Delaware County, Pennsylvania. It has its chief interest from the fact that it was designed by John Thomson, father of J. Edgar Thomson, who became at a much later day president of the Pennsylvania Railroad Company, and who is known as one of the master minds in American transportation progress. Similar records remain of the existence of a short line near Richmond, Va., built to carry supplies to a powder mill, and other lines at Bear Creek Furnace, Pennsylvania, and at Nashua, N. H. But the only one of these roads that seems to have attained a lasting distinction was one built by Gridley Bryant in 1826 to carry granite for the Bunker Hill Monument from the quarries at Quincy, Mass., to the docks four miles distant. This road was built of heavy wooden rails attached in a substantial way to stone sleepers imbedded in the earth. It attained considerable distinction and became of such general interest that a public house was opened alongside its rails to accommodate sightseers from afar who came to see it. This railroad continued in service for more than a quarter of a century.

But the motive power of all these railroads was the horse; and it was patent from the outset that the horse had neither the staying nor the hauling powers to make him a real factor in the railroad situation. So when Horatio Allen returned to New York from England in

January, 1829, with glowing accounts of the success of the English railroads, he found the progressive men of the Delaware & Hudson anxiously awaiting an inspection of the *Stourbridge Lion,* the first of four locomotives purchased by Allen for importation into the United States. Three of these machines were from the works of Foster, Rastrick & Co., of Stourbridge; the fourth was the creation of Stephenson's master hand. The *Lion* arrived in May of that year, and after having been set up on blocks and fired for the benefit of a group of scientific men in New York it was shipped by river and canal to Honesdale.

Allen placed the *Stourbridge Lion* — which resembled a giant grasshopper with its mass of exterior valves, and joints — on the crude wooden track of the railroad, which extended over the mountain to Carbondale, seventeen miles distant. A few days later — the ninth of August, to be exact — he ran the *Lion,* the first turning of an engine wheel upon American soil. Details of that scene have come easily down to to-day. The track was built of heavy hemlock stringers on which bars of iron, two and a quarter inches wide and one-half an inch thick were spiked. The engine weighed seven tons, instead of three tons, as had been expected. It so happened that the rails had become slightly warped just above the terminal of the railroad, where the track crossed the Lackawaxen Creek on a bending trestle. Allen had been warned against this trestle and his only response was to call for passengers upon the initial ride. No one accepted. There was a precious Pennsylvania regard shown for the safety of one's neck. So, after running the engine up and down the coal dock for a few minutes, Allen waved good-bye to the crowd, opened his throttle wide open and dashed away from the village around the abrupt curve and over the trembling trestle at a rate of ten miles an hour. The crowd which had expected to see the engine derailed, broke into resound-

ing cheers. The initial trial of a locomotive in the United States had served to prove its worth.

The career of the *Stourbridge Lion* was short lived. It hauled coal cars for a little time at Honesdale; but it was too big an engine for so slight a railroad, and it was soon dismantled. Its boiler continued to serve the Delaware & Hudson Company for many years at its shops on the hillside above Carbondale. The fate of the three other imported English locomotives remains a mystery. They were brought to New York and stored, eventually to find their way to the scrap heap in some unknown fashion.

Mr. Allen held no short-lived career. His experiments with the locomotive ranked him as a railroad engineer of the highest class, and before the year 1829 closed he was made chief engineer of what was at first known as the Charleston & Hamburg Railroad, and afterwards as the South Carolina Railroad. This was an ambitious project, designed to connect the old Carolina seaport with the Savannah River, one hundred and thirty-six miles distant. It achieved its greatest fame as the railroad which first operated a locomotive of American manufacture.

This engine, called the *Best Friend of Charleston*, was built at the West Point Foundry in New York City and was shipped to Charleston in the Fall of 1830. It was a crude affair, and on its trial trip, on November 2, of that year, it sprung a wheel out of shape and became derailed. Still it was a beginning; and after the wheels had been put in good shape it entered into regular service, which was more than the *Stourbridge Lion* had ever done. It could haul four or five cars with forty or fifty passengers at a speed of from fifteen to twenty-five miles an hour, so the Charleston & Hamburg became the first of our steam railroads with a regular passenger service. A little later, a bigger and better engine, also of

American manufacture and called the *West Point,* was sent down from New York.

Word of these early railroad experiments travelled across the country as if by some magic predecessor of the telegraph. Other railroad projects found themselves under way. Another colliery railroad, a marvellous thing of planes and gravity descents, was built at Mauch Chunk in the Lehigh Valley, and this stout old road is in use to-day as a passenger-carrier.

But it was already seen that the future of the railroad was not to be limited to quarries or collieries. Up in New England the railroad fever had taken hold with force; and in 1831, construction was begun on the Boston & Lowell Railroad. This line was analogous to the Manchester & Liverpool, which proved itself from the beginning a tremendous money-earner. Boston, a seaport of sixty thousand inhabitants was to be linked with Lowell, then possessing but six thousand inhabitants. Still, even in those days, Lowell had developed to a point that saw fifteen thousand tons of freight and thirty-seven thousand passengers handled between the two cities over the Middlesex Canal in 1829.

Then there developed the first of a new sort of antagonism that the railroad was to face. The owners of the canals were keen-sighted enough to discover a dangerous new antagonist in the railroads. They protested to the Legislature that their charter gave them a monopoly of the carrying privileges between Boston and Lowell, and for two years they were able to strangle the ambitions of the proposed railroad. This fight was a type of other battles that were to follow between the canals and the railroads. The various lines that reached across New York State from Albany to Buffalo, paralleling the Erie Canal, were once prohibited from carrying freight, for fear that the canal's supremacy as a carrier might be disturbed. The Baltimore & Ohio Railroad, struggling to

blaze a path toward the West, was for a long time halted by the Chesapeake & Ohio Canal, which proposed to hold to its monopoly of the valley of the Potomac.

The Boston & Lowell, however, conquered its obstacles and was finally opened to traffic, June 26, 1835. Within a few months similar lines reaching from Boston to Worcester on the west, and Providence on the south had also been opened. By 1839 the Boston & Worcester had been extended through to Springfield on the Connecticut River, where it connected with the Western Railroad, extending over the Berkshires to Greenbush, opposite Albany. The Providence Road was rapidly extended through to Stonington, Connecticut. From that point fast steamboats were operated through to New York, and a quick line of communication was established between Boston and New York. Before that time the fastest route between these two cities had been by steamboat to Norwich, then by coach over the post-road up to Boston. Norwich saw the railroad take away its supremacy in the through traffic. Finally it awoke to its necessity, and arranged to build a railroad to reach the existing line at Providence.

Between New York and Philadelphia railroad communication came quickly into being, the first route opened being the Camden & Amboy, which terminated at the end of a long ferry ride from New York. Even after more direct routes had been established and the Delaware crossed at Trenton, it was many years before the trains ran direct from Jersey City into the heart of the Quaker City. The cars from New York used to stop at Tacony, considerably above the city and there was still a steamboat ride down the river.

The railroad route to Baltimore was only a partial one. A steamboat took the traveller to New Castle, Delaware, where a short pioneer railroad crossed to French Town, Maryland. After that there was another long steamboat ride down the flat reaches of the Chesa-

peake Bay before Baltimore was finally reached. A little later there developed an all-rail route between Philadelphia and Baltimore although not upon the line of the present most direct route.

From Philadelphia an early double-track railroad extended west to Columbia, upon the Susquehanna River. An early route extended due north from Baltimore to York, and then to Harrisburg; the parent stem of what afterwards became the Northern Central. A branch from this line was extended through to Columbia, and the New Castle and French Town route lost popularity.

But the Columbia and Philadelphia route was destined to more important things than merely affording an all-rail route to Baltimore. At Columbia it connected with the important Pennsylvania State system of internal canals and railroads, affording a direct line of communication with Pittsburgh and the headwaters of the Ohio River.

This was accomplished by use of a canal through to Hollidaysburgh upon the east slope of the Alleghanies, and the well-famed Alleghany Portage Railroad over the summit of those mountains to Johnstown, where another canal reached down into Pittsburgh and enjoyed unexampled prosperity from 1834 to 1854. The Alleghany Portage railroad was a solidly constructed affair and its rails after the fashion of almost all railroads of that day were laid upon stone sleepers, rows of which may still be seen where the long-since abandoned railroad found its path across the mountains. The Portage Railroad was operated by the most elaborate system of inclined planes ever put to service within the United States; one has only to turn to the pages of Dickens's "American Notes" to read:

"We left Harrisburg on Friday. On Sunday morning we arrived at the foot of the mountain, which is crossed by railroad. There are ten inclined planes, five ascending and five descending; the carriages are dragged up the former and slowly let down the latter by means of *stationary* engines, the comparatively

level spaces between being traversed sometimes by horse and sometimes by engine power, as the case demands. . . . The journey is very carefully made, however, only two carriages travelling together; and while proper precaution is taken, is not to be dreaded for its dangers."

The Portage Railroad was the first to surmount the Alleghanies although in course of time its elaborate system of planes disappeared, as they disappeared elsewhere, under the development of the locomotive.

An interesting feature of the operation of the eastern end of this route of communication across the Keystone State, which was afterwards to develop into the mighty Pennsylvania Railroad, was the communal nature of the enterprise. The railroad was regarded as a highway. Any person was supposedly free to use its rails for the hauling of his produce in his own cars. The theory of the Columbia & Philadelphia Railroad was simply that of an improved turnpike. For ten years after the opening of the line in 1834, the horse-teams of private freight haulers alternated upon the tracks between steam locomotives hauling trains. A team of worn-out horses hauling a four-wheeled car, loaded with farm produce could, and frequently did keep a passenger train hauled by a steam locomotive fretting along for hours behind it. In the end the use of horses was abolished on the Philadelphia & Columbia — the name of the road had been reversed — and in 1857 the road was sold by the State to the newly organized Pennsylvania Railroad Company. The Pennsylvania had already built a through rail route from Columbia over the Alleghanies, and, by the aid of the wonderful Horse Shoe Curve and the Gallitzin Tunnel, through to Pittsburgh; it had created its shop-town of Altoona and abandoned for all time the Alleghany Portage Railroad. But before the consolidation came to pass, two companies had been organized to control freight-carrying upon the tracks of the Philadelphia & Columbia *Railroad.* One of these was the People's line, the other

the Union line; and in them was the germ of the private car lines, which in recent years have become so vexed a problem to the Interstate Commerce Commission.

There were other short railroad lines in Pennsylvania, most of them built to bring the products of the rapidly developing anthracite district down to tidewater. Across New York State another chain of little railroads, which were in their turn to become the main stem of one of America's mightiest systems, was under construction. The first of this chain to be built was the Mohawk & Hudson, extending from the capital city of Albany, by means of a sharply graded plane, to a tableland which brought it in turn to a descending plane at Schenectady. At this last city it enjoyed a connection with the Erie Canal, and for a time the packet-boat men hailed the new railroad as a great help to their trade. It shortened a great time-taking bend in the canal, and helped to popularize that waterway just so much as a passenger carrier.

Afterwards the packet-boat men thought differently. Hardly had the Mohawk & Hudson been opened on August 9, 1831, by an excursion trip behind the American built locomotive *DeWitt Clinton,* when the railroad fever took hold of New York State as hard as the canal fever had taken hold of it but a few years before. Railroads were planned everywhere and some of them were built. Men began to dream of a link of railroads all the way through from Albany to Buffalo and even the troubles of a decade, marked with a monumental financial crash, could not entirely avail to stop railroad-building. The railroads came, step by step; one railroad from Schenectady to Utica, another from that pent-up city to Syracuse, still another from Syracuse to Rochester. From Rochester separate railroads led to Tonawanda and Niagara Falls; to Batavia, Attica, and Buffalo. But the panic of '37 was a hard blow to ambitious financial schemes, and it was six years thereafter before the all-rail route from Albany to Buffalo was a reality.

Even after that it was a crude sort of affair. At several of the large towns across the State the continuity of the rails was broken. Utica was jealous of this privilege and defended it on one occasion through a committee of eminent draymen, 'bus-drivers, and inn-keepers, who went down to Albany to keep two of the early routes from making rail connections within her boundaries. At Rochester there was a similar break, wherein both passengers and freight had to be transported by horses across the city from the railroad that led from the east to the railroad that led towards the west. This matter of carrying passengers across a city has always stimulated local pride. Along in the fifties Erie, Pa., waged a bitter war to prevent the Lake Shore Railroad from making its gauge uniform through that city and abandoning a time-honored transfer of passengers and freight there.

But there seems to be no stopping of the hand of ultimate destiny in railroading. The little weak roads across the Empire State were first gathered into the powerful New York Central, and after a time they were permitted to carry freight, the privilege denied them a long time because of the power of the Erie Canal. After a little longer time there was a great bridge built across the Hudson River at Albany, and soon after the close of the Civil War shrewd old Commodore Vanderbilt brought the railroad that had been built up the east shore of the Hudson, his pet New York & Harlem, and the merged chain of railroads across the State, into the New York Central & Hudson River Railroad, his great lifework. That system spread itself steadily. It built a new short line from Syracuse to Rochester, another from Batavia to Buffalo. It absorbed and it consolidated; gradually it sent its tentacles over the entire imperial strength of New York State.

CHAPTER II

THE GRADUAL DEVELOPMENT OF THE RAILROAD

ALARM OF CANAL-OWNERS AT THE SUCCESS OF RAILROADS — THE MAKING OF THE BALTIMORE & OHIO — THE "TOM THUMB" ENGINE — DIFFICULTIES IN CROSSING THE APPALACHIANS — EXTENSION TO PITTSBURGH — TROUBLES OF THE ERIE RAILROAD — THIS ROAD THE FIRST TO USE THE TELEGRAPH — THE PRAIRIES BEGIN TO BE CROSSED BY RAILWAYS — CHICAGO'S FIRST RAILROAD, THE GALENA & CHICAGO UNION — ILLINOIS CENTRAL — ROCK ISLAND, THE FIRST TO SPAN THE MISSISSIPPI — PROPOSALS TO RUN RAILROADS TO THE PACIFIC — THE CENTRAL PACIFIC ORGANIZED — IT AND THE UNION PACIFIC MEET — OTHER PACIFIC ROADS.

ALL the railroad projects already related were timid projects in the beginning, with hardly a thought of ultimate greatness. Yet there were men, even in the earliest days of railroading, whose minds winged to great enterprises, whose dreams were empire-wide. Of such men was the Baltimore & Ohio born.

Baltimore, like Philadelphia, had greedily watched the success of the Erie Canal upon its completion, and noted with alarm its possible effects upon its own wharves. Philadelphia, with the wealth of the great State of Pennsylvania behind, had sought to protect herself by the construction of the long links of canal and railroad to Pittsburgh, of which you have already read. But Baltimore had no great State to call to her support. She must look to herself for strength. Out of her eminent necessity for self-preservation came men of the strength and the fibre to meet the emergency. Baltimore might have retreated from the situation, as some of the New England towns had retreated from it, and become a somnolent reminiscence of a prosperous Colonial seaport. She did nothing of the sort. Instead she made herself the terminal and

inspiration of a great railroad, laid the foundations of a great and lasting growth.

The Baltimore & Ohio Railroad was born February 12, 1827. On the evening of that day, a little group of citizens of the sturdy old Southern metropolis gathered at the house of George Brown. Mr. Brown together with Philip E. Thomas, a distinguished merchant and philanthropist of Baltimore, had been making investigation into the possibilities of railroads. The fact that the Chesapeake & Ohio Canal, which was already well advanced in construction, would have its eastern terminus at the Potomac River, near Washington, brought no comfort to the merchants of Baltimore. Wonder not then, that the stern old traders of that city assembled to consider "the best means of restoring to the city of Baltimore that portion of the western trade which has lately been diverted from it by the introduction of steam navigation and other causes." From that February day to this the corporate title of the Baltimore & Ohio has been unchanged, despite the career of the most extreme vicissitudes — long years of shadows that were almost complete despair, other years that were brilliant with success.

It was decided at the outset that the commercial supremacy of Baltimore rested on her conquest of the Appalachian Mountains, of her reaching by an easy artificial highway the almost limitless waterways of the West that linked themselves with the navigable Ohio. But for the beginning it was agreed that Cumberland, long an important point on the well-famed National Highway, and even then a centre in the coal traffic, was a far enough distant goal to be worthy of the most ambitious enterprise. Indeed a long cutting through a hill in the first section of the road proved a serious financial obstacle to the directors of the struggling railroad. But these last were men who persevered. They started to lay their track for the thirteen miles from Baltimore to Ellicott's Mills on July 4, 1828. That occasion was honored by an old-

time celebration in which the chief figure was Charles Carroll, of Carrollton, who laid the first stone of the new line. After his services were finished he said to a friend: "I consider this among the most important things of my life, second only to the signing of the Declaration of Independence, if even it be second to that." Of that act President Hadley, of Yale, has written: "One man's life formed the connecting link between the political revolution of the one century and the industrial revolution of the other."

No sooner had actual construction begun on the new line, than the directors found themselves beset by many difficulties. Their enterprise was then so unusual, that they went blindly, stumbling ahead in the dark. Even the construction of the track itself was experimental. It was first planned to use wooden rails hewn from oak, and these were to be mounted upon stone sleepers set in a rock ballast. The money spent in such track was obviously wasted. All such construction had to be torn out before the traffic was at all sizable, and replaced by iron rails and wooden sleepers.

But the track was the least of the company's problems. It had gone ahead to build a railroad with a very vague conception as to its permanent motive-power. It was soon seen there, too, that horses were out of the question for hauling the passengers and freight any considerable distance. The Baltimore & Ohio Company gravely experimented at one time with a car which was carried before the wind by means of mast and sail.

Sturdy old Peter Cooper, of New York, finally solved that motive-power problem. He had been induced to buy three thousand acres of land in the outskirts of Baltimore for speculation. Requests sent by his Baltimore partners for remittances, for taxes and other charges, became so frequent that he went to the Maryland city to investigate. One glance showed him that the future of his investment rested upon the future of the

struggling little railroad which was trying to poke its nose west from Baltimore. He came to the aid of its directors in their problem of motive-power.

That problem consisted, for one thing, in the practical use of a locomotive around curves of 400 feet radius. Cooper went back to New York, bought an engine with a single cylinder, rigged it on a car — not larger than a hand-car, geared it to the wheels of that car and solved the chief problem of the B. & O. His little engine — the *Tom Thumb* — was a primitive enough affair, but it pointed the way to these Baltimore merchants who were pinning their entire faith to their railroad project.

Two years after the beginning of the work, "brigades" of horse-cars were in regular service to Ellicott's Mills; by the first of December, 1831, trains — steam-drawn — ran through to Frederick, Md.; five months later, to a day, they had reached Point of Rocks on the Potomac, seventy miles from Baltimore. At Point of Rocks the road was halted for a long time. The power of the powerful Chesapeake & Ohio Canal, which had been great enough to keep State or national grants from struggling railroads, was raised to defend its claim to a monopoly of the Potomac Valley, by right of priority. This right was sustained in the courts, and the railroad held back two years, until it could buy a compromise.

In 1835, a highly profitable branch was opened to Washington, while early in the following year, trains were running through to Harpers Ferry, at the mouth of the Shenandoah.

During that same Summer of 1835, definite steps were taken toward the extension of the railroad to Pittsburgh, as well as Wheeling. But it was three years later before the struggling company was ready to make a surveying reconnaissance of these extensions of the road. All through that time actual construction work was slowly but quite surely progressing westward from Harpers Ferry,

An early locomotive built by William Norris for the Philadelphia & Reading Railroad

The historic "John Bull" of the Camden & Amboy *Railroad — and its* train

A HEAVY-GRADE TYPE OF LOCOMOTIVE BUILT FOR THE BAL
& OHIO RAILROAD IN 1864. ITS FLARING STACK WAS TYPI
THOSE YEARS

On November 5, 1842, trains entered Cumberland, the one-time objective point of the enterprise.

But beyond Cumberland the road gradually left the comfortable valley of the Potomac, and these early railroad builders found themselves confronted with new difficulties. To build a railroad across the range of the Appalachians, with the primitive methods and machinery of those days was no simple task. For nine years the construction work dragged. In 1851 the line had only been finished to Piedmont, twenty-nine miles west of Cumberland, and its builders were well-nigh discouraged. Let us quote from the ancient history of the B. & O., from which we derive these facts, in an exact paragraph:

"In the Fall of 1851, the Board found themselves, almost without warning, in the midst of a financial crisis, with a family of more than 5,000 laborers and 1,200 horses to be provided for, while their treasury was rapidly growing weaker. The commercial existence of the city of Baltimore depended on the prompt and successful prosecution of the unfinished road."

In October, 1852, it was found that there had been expended for construction west of Cumberland, $7,217,732.51. But the road was going ahead once more. Its Board had dug deep into their pockets and the commercial crisis that hovered over Baltimore was passed. Two years later the road entered Wheeling, and its corporate title was no longer a misnomer.

A little later, a more direct line was built to Parkersburg, West Virginia, and direct connection entered with the Ohio & Mississippi Railroad, which reached St. Louis. The railroad was beginning to feel its way out across the land.

War between North and South had been declared before the long delayed extension to Pittsburgh was finished. In that time a real master-hand had come to the Baltimore & Ohio. In its early days the names of Philip E. Thomas, Peter Cooper, Ross Winans, and B. H. Latrobe

were indissolubly linked with this pioneer railroad; in its second era John W. Garrett gave brilliancy to its administration. Even before, as well as throughout the four trying years of the war, when the road's tracks were being repeatedly torn up and its bridges burned, Mr. Garrett was laying down his masterly policy of expansion. It was a discouraging beginning that confronted him. The two expensive extensions to the Ohio River had been a severe drain on the company's treasury, traffic was at low ebb, the great financial panic of 1857 had been hard to surmount.

But Mr. Garrett was one of the first of American railroaders to see that a trunk-line should start at the seaboard and end at Chicago or the Mississippi. He pushed his line to Pittsburgh, to Cleveland, to Sandusky, to Chicago. It began to reach new and growing traffic centres. The Baltimore & Ohio entered upon an era of magnificent prosperity.

The first cloud upon that era came in the early seventies, when its powerful rival, the Pennsylvania, secured control of the Philadelphia, Wilmington & Baltimore, the B. & O.'s connecting link on its immensely profitable through route from New York to Washington. Pennsylvania interests tunnelled for long miles through the rocky foundations of Baltimore, purchased an independent line to Washington — the Baltimore & Potomac — and the B. & O. found itself deprived of its best congested traffic district. For eleven years it was unable to retaliate, though not a soul believed the Baltimore & Ohio to be other than a splendid, conservative property. It owned its own sleeping-car company, its own express company, its own telegraph company. The name of Garrett was behind it. Logan G. McPherson says:

"When it was desired to obtain additional funds, bonds were always issued instead of the capital stock being increased. Interest on bonds has always to be met, whereas dividends on stocks can be passed. It was announced, however, that the retention

of the stock capitalization at less than fifteen millions of dollars was an evidence of conservatism, as the continuance of semi-annual dividends of five per cent was thereby permitted."

John W. Garrett died in 1884, and was succeeded in the presidency by his son Robert Garrett, who announced himself ready to continue a policy of expansion. The younger Garrett sought to regain an entrance for his traffic to New York. To that end he built a line into Philadelphia and prepared to strike across the State of New Jersey. He failed in that end by the failure of one of his confidential aides; the line that he had counted on for entrance into the American metropolis was snapped up by his greatest rival just as his own fingers were almost upon it. Later the B. & O. was permitted a trackage entrance into Jersey City, but the terms of that entrance were so stringent as to mean a practical surrender upon its part.

If Baltimore & Ohio had won that battle, a different story might have been chronicled. As it was, it stood a loser in a fearfully expensive fight; the English investors in the property became investigators — of a sudden the bottom dropped out of things. The stock went slipping down as only a mob-chased stock in Wall Street can drop; the road that had been the pride of Baltimore became, for the moment, her shame. It was shown, upon investigation, that the road had long gone upon a slender standing: millions of dollars that should actually have been charged to loss had been charged against its capital and included in the surplus. Ten years after Mr. Garrett's death the road found itself in even more bitter straits. It was a laughing stock and a reproach among railroad men. Its profitable side-properties — the sleeping-car company, the express company, the telegraph company,— the first two of which should never be permitted to go outside of the control of any really great railroad company — had been sold, one after another, in attempts to save the day of reckoning. Just before the Chicago Fair the road reached

low-water mark. Its passenger cars were weather-beaten and ravaged almost beyond hope of paint-shops; it was sometimes necessary to hold outgoing trains in the famous old Camden station at Baltimore, until the lamps and drinking glasses could be secured from some incoming train. In that day of low-water mark it was actually and seriously proposed to abandon the passenger service of the road!

Out of that chaos came the B. & O. of to-day, a substantial and well-managed railroad property. Mr. Garrett was the first of the railroaders to construct a single property from the Atlantic seaboard to the Mississippi; John F. Cowan, L. F. Loree, Oscar G. Murray, and Daniel Willard have been his successors in the revamping of the B. & O., eliminating its costly grades, enlarging yard and terminal facilities, and making the historic road a carrier of the first class.

The history of the Erie Railroad is hardly less dramatic than that of the Baltimore & Ohio; its financial disasters were not owing to the errors that come of crass stupidity. For the Erie did its good part in the making of railroad law. Built and operated in the earliest railroad days as a single enterprise through the southern tier of counties of New York State from the Hudson River to Lake Erie, while the roads to the north that were eventually to be welded by Commodore Vanderbilt into the great New York Central were still quarrelling among themselves, it was wrecked time and time again by unscrupulous schemes of high finance. It was made to wear mill-stones in the shape of outrageous bonded indebtednesses that acted as a fearful handicap for many years and prevented a remarkably well located property from standing to-day as the peer of the Pennsylvania or of the New York Central. The story of these outrages has been told and retold — they are integral parts of the financial history of the country. Suffice it to say here and now that the Erie

has been operated with more or less success by no less than four struggling corporations; that it has never come closer to achieving success than under its present president, F. D. Underwood; and that no one save those who have stood close to Underwood has known or appreciated the heritage of handicap that was given to him to shoulder. For it has been part of our railroad principle in this country — a mighty sad part, too — that no matter how villainously stocks and bonds may have been issued at any time — only to bring failure swiftly and inevitably,— such bogus paper has always been protected in reorganization. A railroad which becomes bankrupt cannot be abandoned. That has been done only in rare cases. Even the Baltimore & Ohio, at the end of its rope less than twenty years ago, was not permitted to abandon its passenger service. It must pull itself up out of the difficulties, and — in America at least — it must pull its trashy paper up too, in order that no holder of such paper may be unprotected. The paper can no more be abandoned than the right-of-way. The result is seen in railroads staggering under vast and questionable capitalization (there is no cleaning of the slate); but the sins of those that have gone before are truly visited upon the third and the fourth generation, as well as upon the poor humans who, under such burdens, are trying to operate a railroad property.

From the beginning the story of Erie has been a story of difficulties. The original scheme of building a New York railroad from Piermont-on-Hudson to Dunkirk on Lake Erie — some 450 miles — seems in the face of the resources of the State at that time and the engineering difficulties to be solved, almost quixotic. But the road was built step by step, section by section, until in May, 1851, a triumphal first train was operated over its entire length. President Fillmore was the guest of honor on the train, but shared attention with Daniel Webster on the trip. Webster, in order that he might see the country, insisted on making the entire tedious journey in a rocking-chair,

which was lashed upon a flat-car. Another flat-car was occupied by a railroad officer who was designated to receive the flags. C. F. Carter, in his interesting sketch on the early days of the Erie, writes:

"By a singular coincidence, the ladies at every one of the more than sixty stations between Piermont and Dunkirk had conceived the idea that it would be as original as it was appropriate to present a flag wrought by their own fair hands to the railroad company when the first train passed through to Lake Erie. As it would have consumed altogether too much time to make a stop for each of these flag presentations, the engineer merely slowed down at three-fourths of the stations long enough to permit the man on the flat-car to scoop up the banners in his arms, much like the hands on the old-fashioned Marsh harvesters gathered up armfuls of grain for binding. At the end of the journey the Erie Railroad had a collection of flags that would have done credit to a victorious army."

Mr. Carter has also told how in that same eventful year 1851 the telegraph came into use on the Erie, first of all railroads: A crude telegraph line, built for commercial purposes, had been stretched along the eastern end of the road. People did not think very much of the telegraph in those days. It was only seven years old; and when a man wired another man he wrote his message like a letter, beginning with "Dear sir" and ending with "Yours truly." The railroads scorned its use. Their trains ran by hard and fast train rules. Then, as now, north and east-bound trains held the right-of-way over those south and west-bound, and the meeting places on single-track lines were each carefully designated on the time-card. If a train was waiting for another coming in an opposite direction, and the train came not after an hour, the first train proceeded forward "under flag." That meant that a man, walking with a flag in his hand preceded the train to protect it. The locomotive and its train of cars necessarily proceeded at snail's pace.

It was not so very long after that observation-car trip

that Daniel Webster took in the rocking-chair up to Dunkirk, before the Erie's superintendent, Charles Minot, was taking a trip up over the east end of the road. The train on which he was riding was due to meet a west-bound express at Turner's. After waiting nearly an hour there, without seeing the opposing train, Minot was seized with an inspiration. He telegraphed up the line fourteen miles to Goshen to hold that west-bound train until he should arrive there. He then ordered his train-crew to proceed. They rebelled. Engineer Isaac Lewis had too much regard for his own precious neck to break the time-card rules, even under the superintendent's orders. So finally Minot took charge of the engine himself, while Lewis cautiously seated himself in the last seat of the last car and awaited the worst.

It never came, of course. When they reached Goshen, the agent had received the message, and was prepared to hold the west-bound train. But it had not arrived, and Minot by repeating his method was enabled first to reach Middletown and then Port Jervis before meeting the delayed train. By the use of the telegraph he had saved his own train some three hours in running time; and it was not long thereafter until the operation of trains by telegraph order became standard on the Erie and all others of the early railroads.

At the beginning, one of the promoters of the Erie announced his belief that the road would eventually earn, by freight alone, "some two hundred thousand dollars in a year," and his neighbors laughed at him for his extravagant promise. Yet, in the first six months' operation of the road the receipts — mostly from freight — were $1,755,285.

To tell the full story of Erie would require a sizable book. It has not yet been told. It is a story of intrigue and deceit, of trickery and of scheming; the story of Daniel Drew and Jim Fisk and Jay Gould; the monumental tragedy of the wrecking of a great railroad property —

a property with possibilities that probably will never now be realized. The present management of the road has labored valiantly and well. It has seen the future of Erie as a great freighting road, has carefully laid its lines for the full development of the property as a carrier of goods, rather than of through passengers.

The history of the railroad divides itself sharply into epochs. In the beginning, the different roads — such as Erie, Pennsylvania, Baltimore & Ohio, and New York Central — were being pushed west over the Alleghany Mountains to the Great Lakes and the Ohio River. There followed an era where the railroads were reaching Chicago and St. Louis. That was the era which saw the weird railroads of the Middle West, the strange stock-watering companies that made the very names of Ohio, Michigan, and Illinois financial bywords in the late forties and the early fifties. The first railroad in Ohio was the old Mad River & Lake Erie, which was built in 1835, from Sandusky, south about a hundred miles to Columbus, the State capital. The pioneer engine on the road, the *Sandusky,* was the first locomotive ever equipped with a whistle.

The first railroad of the prairies was the Northern Cross railroad — now a part of the Wabash — extending from Merodosia on the Illinois River, to Springfield. It was started in 1837, and late in the following fall a locomotive built by Rogers, Grosvenor, and Ketchum of Paterson, N. J.,— the founders of a famous locomotive works — was landed from a packet-steamer at Merodosia. Then was the first puff of a locomotive heard upon the prairies of the great West. A contemporary account says:

"The little locomotive had no whistle, no spark-arrester, no cow-catcher, and the cab was open to the sky. Its speed was about six miles an hour, and where the railroad and the highway lay parallel to each other there was frequently a trial of speed between the locomotive with its 'pleasure cars' and the stage-

coaches. Sometimes the stage-coaches came in ahead. Six inches of snow were sufficient to blockade the trains drawn by this American engine."

In 1846 James M. Forbes was building the Michigan Central west from Detroit, 145 miles to Kalamazoo. A little later it was extended to the east shore of Lake Michigan, at New Buffalo; eventually it reached Chicago with its own rails. While the Michigan Central was pushing its rails, its chief competitor to the south, the Michigan Southern,— afterwards a part of the Lake Shore, and eventually united with its traditional rival in the extended New York Central system — was also pushing toward Chicago as a goal. Both roads reached Chicago in 1852. But railroad building was slow work. The country expanded too quickly after the golden promises of the railroad promoters. Money came too easily; then there would come a fearful financial time, and the reputable railroad enterprises would be halted beside the "fly-by-night" schemes. As late as 1850, Ohio had only the single trunk-line connecting Sandusky and Cincinnati; but the railroad to Cleveland that was afterwards the main stem of the Big Four and the trunk-line connection east to the Baltimore & Ohio, were nearing completion.

Chicago's first railroad was the Galena & Chicago Union, and it was the cornerstone of the great Chicago and Northwestern system, one of the really great railroads of America. The Galena & Chicago Union was incorporated in 1836, but not until eleven years later was work begun in laying tracks, for a short ten-mile stretch from the Chicago River to Des Plaines; and its first locomotive, the *Pioneer*, had been bought second-hand from the Buffalo & Attica Railroad, away east in New York State. The rails were second-hand, too, of the strap variety, which the Western railroads were already discarding in favor of solid rails. But it was a railroad, and it was with a deal

of pride that John B. Turner, its president, used to ascend to an observatory on the second floor of the old Halsted Street depot to sight with a telescope the smoke of his morning train coming across the prairie. The Chicago and Northwestern, itself, was organized in 1859. For a time it was so desperately poor that it could not pay the interest on its bonds, and there was a time when its officers had to meet the pay-roll out of their own pockets; but it succeeded in absorbing about six hundred miles of railroad at the beginning. In another decade the Union Pacific Railroad, first uniting the Far West with the populous Middle and Eastern States, was completed. The Chicago and Northwestern formed one of the most direct links between the Lakes and the eastern terminal of the Union Pacific at Council Bluffs. The business that came to it because of that linking was the first strong impulse that led to the ultimate greatness of the Northwestern.

The distinctive mid-Western road was and always has been the Illinois Central. Originally incorporated in 1836, it was nearly twenty years later when, through substantial aid from the State whose name it bears, construction actually began. The first track was laid from Chicago to Calumet to give an entrance to the Michigan Central in its heart-breaking race to the Western metropolis against the Michigan Southern. The main line through to Cairo was pushed forward rapidly, however, and was ready for traffic at the end of 1855. A large number of Kentucky slaves promptly showed their appreciation of the new railroad enterprise by using it to effect their escape to the North.

Of course with the railroad pushing its way westward all the while (the Rock Island in April, 1859, was the first to span the Mississippi with a bridge), it was only a question of time when some adventurous soul should seek to reach the Pacific coast. Indeed it was away back in 1832, while there was still less than a hundred miles of track

in the United States, that Judge Dexter of Ann Arbor, Michigan, proposed a railroad through to the Pacific Ocean, through thousands of miles of untrodden forest. Six years later, a Welsh engineer, John Plumbe, held a convention at Dubuque, Iowa, for the same purpose. The idea would not down. Hardly had Plumbe and his convention disappeared from the public notice when Asa Whitney, a New York merchant of considerable reputation, began to agitate the Pacific railroad. Whitney was a good deal of a theorist and a dreamer; but he was a shrewd publicity man, and he held widely attended meetings for the propagation of his idea, in all the Eastern cities. Eventually, like Judge Dexter and John Plumbe, he was doomed to disappointment. After Whitney had died broken-hearted and bankrupt because of his devotion to an idea, came Josiah Perham, of Boston. Josiah Perham was the Raymond & Whitcomb of the fifties. He began by organizing excursions for New England folk to come to Boston to see the Boston Museum and the panoramas, which were the gay diversion of that day. In one year he brought two hundred thousand folk into that sacred Massachusetts town, and he began to be rated as a rich man. He absorbed the Pacific railroad idea and freely spent his money in its propagation. He organized the People's Pacific Railroad,— and a part of his scheme formed the foundation of the Northern Pacific. Perham, like the others, spent his money and failed to see the fruition of his plan. There seemed to be something ill-fated about that plan of a railroad to the Pacific. Even the citizens of St. Louis, who had gathered on the Fourth of July, 1851, to see soil broken for the first real transcontinental railroad, found that it could only manage to reach Kansas City by 1856. That particular railroad — the Missouri Pacific — through its western connection, the Western Pacific, only succeeded in reaching the coast within the past year.

When Theodore D. Judah brought himself to the seem-

ingly hopeless task of trying to build a Pacific railroad, he brought with him all the enthusiasm of Asa Whitney, and with it the experience of a trained railroad engineer. The thing was beginning to take shape. The men, like Whitney and Perham, who had been before Congress at session after session, finally brought that august body, even when the nation stood on the verge of civil war, into making an appropriation for a survey for a scheme, which nine out of ten men regarded as a mere visionary dream. Theodore D. Judah, filled with enthusiasm for his mighty plan, went West that he might roughly plan the location of the railroad. He went to San Francisco and he went to Sacramento, where the little twenty-two-mile Sacramento Valley Railroad had been running since 1856. The Californians listened to him with interest, but they proffered him no financial aid. Then Judah went up into the high passes of the Sierras, through which a railroad to the east would certainly have to reach, to find a crossing for the line in which he believed so earnestly. He found it — making a route that would save 148 miles and $13,500,000 over that proposed by the Government authorities. When he went back to Sacramento, to the hardware store of his old friends, Huntington & Hopkins, in K Street, it was with a rough profile of that pass in his pocket. What Judah said to Collis P. Huntington and Mark Hopkins has never been known, but certain it is that in a little time they were sending for the three other capitalists of Sacramento — the Crocker brothers, who had a dry-goods store down the street, and Leland Stanford, a wholesale grocer. Out of the efforts of those six men the Central Pacific Railroad was organized with a capital of $125,000. Work began on the new line at Sacramento on the first day of 1863, while California shook with laughter at the idea of a parcel of country store-keepers building a railroad across the crest of the Sierras.

How they built their railroad successfully and amassed

six really great American fortunes is all history now. Sufficient is it that they turned a deaf ear to the ridicule (the project was considered so visionary that bankers dared not subscribe to the stock of the road for fear of injuring their credit), found their route through the mountains just as Judah had promised, brought their materials around the Horn, imported ten thousand Chinese laborers, hurled thousands of tons of solid rock down among the pines by a single charge of nitro-glycerine, bolted their snow-sheds to the mountains, and filled up or bridged hundreds of chasms and valleys. "Two thousand feet of granite barred the way upon the mountain-top where eagles were at home. The Chinese wall was a toy beside it. It could neither be surmounted nor doubled; and so they tunnelled what looks like a bank swallow's hole from a thousand feet below. Powder enough was expended in persuading the iron crags and cliffs to be a thoroughfare, to fight half the battles of the Revolution."

While the Central Pacific was being built east from the coast, the Union Pacific was pushing its rails west from the Missouri River to meet it. A Federal subsidy was paid to each road for each mile of transcontinental track it laid, and the result was the Credit Mobilier, the worst financial blot upon the pages of American government transactions. Early in the Spring of 1868 the companies were on equal terms in this great game of subsidy getting. Each finally had ample funds and each was about 530 miles away from the Great Salt Lake. So in 1868 a construction campaign began that has never been approached in the history of railroad building. Twenty-five thousand men, and 6,000 teams, together with whole brigades of locomotives and work-trains, were engaged in the work; in a single day ten miles of track was laid and that was a world-beating record. The result of such speed was that the two railroads met, May 9, 1869. Leland Stanford, who was ridiculed when he first turned earth for the Central Pacific

at Sacramento six years before, drove the last spike, and was for that moment the central figure in an attention that was world-wide.

After the Union Pacific and the Central Pacific came the Southern Pacific, and after them came Collis P. Huntington binding them into a tight single railroad. But close on the heels of the Southern Pacific, and right into its own territory, reached the Santa Fe, while to the north, first the Northern Pacific and then the Great Northern was built from the lake country straight to Puget Sound. On a November day in 1885 the last spike was driven in the great transcontinental Canadian Pacific, the first and so far the only railroad to lay its rails from the North Atlantic to the Pacific. Within a year the Western Pacific — the westernmost of the chain of Gould roads — has begun to run its through trains to the Golden Gate. As this volume goes to press finishing touches are being placed upon the Puget Sound extension of the Chicago, Milwaukee & St. Paul, probably the last transcontinental to be stretched across these United States for a number of years to come. Far to the north, the Grand Trunk Pacific is finding its way across the wilderness of the Canadian Rockies, creating a great city — Prince Rupert — at its western terminal. It should be ready for its through traffic within the next three years.

This then, in brief, is the history of American railroading — an eighty-year struggle from East to West. The railroad has passed through many vicissitudes; days of wild-cat financing, and days when men refused to invest their money under any inducements whatsoever. It has been assailed by legislatures and by Congress; it has been scourged because of the so-called "pooling agreements," and it has cut its own strong arms by building foolish competing lines. But it has survived masterfully, while the highroads have become grass-grown, and the once proud

canals have fallen into decay. Railroading is to-day in the full flush of successful existence. Science has been brought to each of the infinite details of the business; and for the first time the country sees practically every line, large or small, honestly earning its way. The railroad receiver has all but passed into history.

CHAPTER III

THE BUILDING OF A RAILROAD

COST OF A SINGLE-TRACK ROAD — FINANCING — SECURING A CHARTER — SURVEY-WORK AND ITS DANGERS — GRADES — CONSTRUCTION — TRACK-LAYING.

THE railroad has its beginning in the inspiration and in the imagination of men. Perchance a great tract of country, rich in possibilities, stands undeveloped for lack of transportation facilities. The living arm of the railroad will bring to it both strength and growth. It will bring to it the materials, the men, and the machinery needed for its development. It will take from it its products seeking markets in communities already established.

In that way the first railroads began, reaching their arms carefully in from the Atlantic and the navigable rivers and bays that emptied into it. In the beginning there was hardly any inland country. All the important towns were spread along the sea-coast or along those same navigable tributaries, and it was sorry shrift for any community that did not possess a wharf to which vessels of considerable tonnage might attain. Where such communities did not possess natural water-ways, they sought to obtain artificial ones; and the result was the extraordinary impetus that was given to the building of canals during the first half of the nineteenth century — a page of American industrial history that has been told in another chapter.

It was found quite impossible to handle bulky freight economically by wagon, no matter how romantic the turnpike might be for passenger traffic in the old-time coaches. The canal was so much better as a carrier that it was

hailed with acclaim, and waxed powerful. In the height of its power it laughed at the puny efforts of the railroad, and then, as you have seen, sought by every possible means to throttle the growth of the steel highway. Within eighty years it was powerless, and the railroad was conqueror. There were hundreds of miles of abandoned canal within the country, many of them being converted into roadbeds of railroads; and the water-highway, with its slow transit and its utter helplessness during the frozen months of the year, was not able to exist except where quantities of the coarsest sort of freight were to be moved.

Without railroads, the United States to-day would, in all probability, not be radically different from the United States of a hundred years ago. All the large towns and cities would still be clustered upon the coast and waterways, and back of them would still rest many, many square miles of undeveloped country; the nation would have remained a sprawling, helpless thing, weakened by its very size, and subject both to internal conflict and to attacks of foreign invaders. It has been repeatedly said that if there had been a through railroad development in the South during the fifties, there would have been no Civil War. France for five hundred years before the signing of our Declaration, was a civilized and progressive nation. Yet century after century passed without her inland towns showing material change; and her seaports, lacking the impetus of interior growth, remained quiescent. Such a metropolis as Marseilles is to-day, became possible only when the railroad made this seaport the south gate of a mightily developing nation.

Let us assume that we are about to build a railroad. If we are going to strike our road in from some existing line or some accessible port into virgin country, we may hope for land or money grants from the State, county, town, or city Government. *That is a faint* hope, however, in

these piping days of the twentieth century. So much scandal once attached itself to these grants that they have become all but obsolete. We shall have to fall back upon the individual enterprise and help of the persons who are to benefit by the coming of the railroad. They may be folk who simply regard our project as a good investment, and place their money in it with hopes of a fair return.

Even if we are not going into virgin territory to give whole townships and counties their first sight of the locomotive, but are going to strike into a community already provided with railroad facilities but seemingly offering fair opportunity for profit in a competitive traffic, we shall find capital ready to stand back of us. A railroad will cost much money, the mere cost of single-track construction generally running far in excess of $35,000 a mile; and it should have resources, particularly in a highly competitive territory, to enable it to carry on a losing fight at the first.

For the money it receives it will issue securities, upon incorporation and legal organization, almost invariably in the form of capital stock and of mortgage-bonds. The stock will probably be held by the men who wish to control the construction and the operation of the line; the bonds will be issued to those persons who invest their money in it, either for profit or as an aid to the community it seeks to enter. The bonds are, in almost all cases, the preferable security. They pay a guaranteed interest at a certain rate, and at the end of a designated term of years they are redeemable at face value, in cash or in the capital stock of the company. There are other forms of loan obligations which the railroad issues — debenture bonds, second-mortgage bonds, short-term notes, and the like. To enter upon a description of these would mean a detour into the devious highways and byways of railroad finance — an excursion which we have no desire to make in this book.

In building our line we will issue as few bonds in proportion to our stock as will make our company fairly stable *in organization*, and its proposition attractive to investors.

For we shall have to pay our interest coupons upon the bonds from the beginning. We can begin even moderate dividends upon our stock after our enterprise has entered upon fair sailing. The all-important initial problem of financing having been at least partly settled, we will go before the Legislature and secure a charter for our road. In these modern days we shall probably have also to make application to some State railroad or public utility commission. It will consider our case with great care, granting hearings so that we may state our plans, and that folk living in the territory which we are about to tap may urge the necessity of our coming, and that rival railroads or other opponents may state their objections. After the entire evidence has been sifted down and weighed in truly judicial fashion, we may hope for word to "go ahead," from the official commission, which, though it assumes none of our risk of loss in projecting the line, will gratuitously assume many of the details of its management.

Perhaps the politicians will poke their noses into our plan; they sometimes do. If we have plenty of capital behind us; if it becomes rumored that the P — or the N — or the X —, one of the big existing properties, is back of us, or some "big Wall Street fellow" is guiding our bonds, we can almost confidently expect their interference. After that it becomes a matter of diplomacy — and may the best man win!

Let us assume that some of these big obstacles have already been passed, that the politicians have been placed at arm's length, that the money needed is in sight — we are ready to begin the construction of our line. The location is the thing that next vexes us. A few errors in the placing of our line may spell failure for the whole enterprise. Obviously, these errors will be of the sort that admit of no easy correction.

If our line is to link two important traffic centres and

CONSTRUCTION ENGINEERS BLAZE THEIR WAY ACROSS THE FACE OF NEW COUNTRY

THE MAKING OF AN EMBANKMENT BY DUMP-TRAIN

"SMALL TEMPORARY RAILROADS PEOPLED WITH HORDES OF RESTLESS ENGINES"

veying party consists of a front flag-man, who is a captain and commands a brigade of axe-men in their work of cutting away trees and bushes; the transit-man, who makes his record of distances and angles and commands his brigade of chain-men and flag-men; and the leveller, who studies contour all the while, and supervisors, rod-men and more axe-men. Topographers are carried, their big drawing boards being strapped with the camp equipment; and a good cook is a big detail not likely to be overlooked.

In soft and rolling country this is a form of camp life that turns back the scoffer: busy summer days and indolent summer nights around the camp-fire, pipes drawing well and plans being set for the morrow's work. Another summer all this will be changed. The resistless path of the railroad will be stepped through here, the group of nodding pines will be gone, for a culvert will span the creek at this very point.

Sometimes the work of these parties becomes intense and dramatic. The chief, lowered into a deep and rocky river cañon, is making rough notes and sketches, following the character of the rock formation, and dreaming the great dreams that all great engineers, great architects, great creators must dream perforce. He is dreaming of the day when, a year or two hence, the railroad's path shall have crowded itself into this *impasse,* and when the folk who dine luxuriously in the showy cars will fret because of the curve that spills their soup, and who never know of the man who was slipped down over a six-hundred-foot cliff in order that the railroad might find its way.

It is then that the surveying party begins to have its thrills. Perhaps to put that line through the cañon the party will have to descend the river in canoes. If the river be too rough, then there is the alternative of being lowered over the cliffsides. Talk of your dangers of Alpine climbing! The engineers who plan and build railroads through any mountainous country miss not a single one of them. Everywhere the lines must find a foothold.

This is the proposition that admits of but one answer solution. Sometimes the men who follow the chief the deep river cañons, the men with heavy instruments carry and to operate — transits, levels, and the like must have lines of logs strung together for their precari foothold as they work. Sometimes the foothold is lo the rope that lowers the engineer down over the cliffs snaps, and the folk in the cheerful dining-room do know of the graves that are dug beside the railroad's sistless path.

It is all new and wonderful, blazing this path for civ zation; sometimes it is even accidental. An engine baffled to find a crossing over the Rockies for a tra continental route saw an eagle disappear through a cl in the hills that his eye had not before detected. H followed the course of the eagle; to-day the rails of t transcontinental reach through that cleft, and the tim table shows it as Eagle Pass.

Possibly there are still alternative routes when the su veyers return in the fall and begin to make their finish drawings. Final choices must now be made, and lan maps that show the property that the railroad will have acquire, prepared. The details, of infinite number, a being worked out with infinite care.

The great problem of all is the problem of grade in a mountainous stretch of line this is almost the enti problem. Obviously a perfect stretch of railroad woul be straight and without grades. The railroad that com nearest that practically impossible standard comes neare to perfection. But as it comes near this perfection, the co of construction multiplies many times. Most new lin must feel their way carefully at the outset. Moreover is not an impossible thing to reconstruct it after years affluence — of which more in another chapter.

A three-per-cent grade is almost the extreme limit f

anything like a profitable operation; even a two-per-cent grade is one in which the operating people look forward to reconstruction and elimination. Yet there are short lengths of line up in the mining camps of Colorado, where grades of more than four per cent are operated; and it is a matter of railroad history that away back in 1852, when the Baltimore & Ohio Railroad was being pushed through toward Parkersburg, and the great Kingwood tunnel was being dug, B. H. Latrobe, the chief engineer of the company, built and successfully operated a temporary line over the divide at a grade of ten per cent — 528 feet to the mile. A locomotive which weighed 28 tons on its driving-wheels carried a single passenger car, weighing 15 tons, in safety and in regular operation over this stupendous grade for more than six months. The ascent was made by means of zigzag tracks on the so-called switchback principle. That scheme succeeded earlier planes operated by endless chains; an instance of which is the quite famous road of Mauch Chunk, originally operated for coal, and now a side scenic trip for passengers. Other planes of this sort, you will remember, were in operation at Albany and Schenectady on the old Mohawk & Hudson route, now a part of the New York Central lines; but all of them involved a change of passengers and freight to and from their cars, and the zigzag switchback was considered quite an advance in its day. Two of these ancient switchbacks are still in regular use for passengers and freight — one at Honesdale, Pa., and the other at Ithaca, N. Y.

The matter of grades being settled, and with it as a corrollary the question of minor curves, minor details next claim attention. Perhaps the water supply along the new line is defective. Then arrangements must be made for impounding, and perhaps suitable dams and waterworks will be built for this purpose. The water must be soft, to protect the locomotive boilers; if hard, an apparatus

is erected for the softening process. Grade crossings are to be avoided, highway crossings being built, wherever possible, over or under the railroad.

A railroad crossing another railroad at grade is an abomination not to be permitted nowadays. The universal use of the air-brake has permitted a reduction of the "head-room,"— the necessary clearance between the rail and overhead obstruction — from 20 feet to 14 feet. The old "head-room" was necessary to protect the brakeman who worked atop of the box-cars. This reduction of six feet in clearance was a matter of infinite relief to engineers, particularly in the bridging of one railroad over another.

The entire problem of bridges is so intricate a phase of American railroad construction as to demand attention in a subsequent chapter. In actual railroad practice it is apt to demand a separate branch of engineering skill, both in construction and in maintenance. We turn our attention back to the main problem of the building of our railroad.

When all plans are finished, contracts remain to be divided and sub-divided; for it would be a brave contractor, indeed, who in these days would consent to essay himself, any considerable length of railroad line. In fact, in recent work of heavy nature, the price is almost invariably placed at an indefinite figure, a certain definite percentage of profit being allowed the contractor on each cubic yard of rock or soil. In such a case the contractor's business becomes far less a game of chance; he is, in effect, the railroad's agent supervising its construction at a certain set stipend.

Let us say that the construction on our railroad begins in the early spring. As a matter of real fact it would not be halted long because of adverse weather conditions. Even up in the frozen and uninhabitable wilds of the Canadian Northwest, work has been prosecuted on the new Grand Trunk Pacific throughout the entire twelve

months. But in summer the construction gangs rejoice. The great proposition of bringing mile after mile of future railroad to sub-grade — the level upon which the cross-ties are to be set — fairly sweeps forward under the genial warmth of the sun. The construction is under the supervision of competent engineers, who are, of course, under the direct supervision of the railroad's own organization. Every six to twelve or fifteen miles of new line is divided into sections, better known as residencies, for each is under the eye of its own resident engineer. He reports to the construction engineer, who in turn reports to the chief engineer of the railroad, an officer who reports to no less person than the president of the company.

This great force — for each engineer has gathered about him a competent staff of young men as expert with compass, with level, and with transit as were the men who first projected the line — is in the field as quickly as the contractor. They are to see him bring the line to sub-grade; to see him place bridges and culverts, bisect high hills with cuttings, bore tunnels through even higher hills and mountains, span deep valleys with great embankments. To facilitate quick construction the residencies are made numerous; work begins at as many initial points as possible. These points, of course, are situated, where possible, close to water communication or existing railroad lines, in order that material may be brought with the least possible delay and expense.

Of course, if the country has a sharp contour, the ordinary difficulties of line-construction multiply very rapidly. The great cuttings through the hills may have to be carved out of resisting rock, a work that is carried on through many levels, known to the engineers as ledges or as benches. If there are high hills to be notched there will probably be great hollows where the circumstances do not justify carrying the line on bridge or trestle. In these cases come the fills, *or embankments*. We have already

shown how the locating engineer in the first instance has tried to plan his line so that the earth or rock from his cutting will be as nearly as possible sufficient to form the near-by embankments. Sometimes it is not, and then the resident engineers must locate borrow-pits, where the hungry demand of the railroad for dirt will cause a great hollow to show itself on the face of the earth. The borrow-pit must be carefully located — convenient of access, far enough from the track not to be a danger spot to it. This is one of the infinity of problems that come to the construction engineer.

For these big jobs laborers' camps will be established close to them; and small temporary railroads peopled with hordes of restless dummy-engines and forcing their narrow-gauged rails here and there and everywhere, will be busy for long weeks and months. There will not be much hand-cutting in the ledges. Steam shovels, mounted like locomotives upon the rails, and pushing forward all the while, will fairly eat out the hillside. One of these will catch up in a single dip of his giant arm more than a wagon load of soft earth or of rock that has been blasted apart for his coming.

To make the fills the engineers must often build rough wooden trestles out of the permanent level of the line. The dummy-engines, with their trails of dump-cars, coming from the back of the steam shovels in the cutting, or from the nearest borrow-pit, will hardly seem in a single day to make an appreciable effect upon the fill. But the days and weeks together count, and the dumping multiplies until the rough trestle has completely disappeared, and the railroad has a firm and permanent path across the edge of the dizzy embankment. And these embankments can be made truly dizzy. The passenger going west from Omaha on the new Lane cut-off of the Union Pacific finds his path for almost twenty miles through deep cuttings of the crests of the rolling Nebraska hills, across the edge of the long fills over wide valleys. The Lackawanna rail-

CUTTING A PATH FOR THE RAILROAD THROUGH THE CREST OF THE HIGH HILLS

A GIANT FILL — IN THE MAKING

THE FINISHING TOUCHES TO THE TRACK

THIS MACHINE CAN LAY A MILE OF TRACK A DAY

road building a great cut-off on its main line where it passes through New Jersey has just finished the largest railroad embankment ever built — an earthen structure for two tracks, three miles long and seventy-five to one hundred and ten feet in height.

As the line goes forward, the track follows. The new railroad has probably popularized itself from the outset by hiring the near-by farmers and their teams to grade the line through their localities, particularly where an almost level country makes the grading a slight matter. Sometimes in level country, grading machines, drawn by horses, or by traction engines, have been used to advantage. These machines are equipped with ploughs which loosen the soil and place it on conveyor belts. Material can be deposited twenty-two feet away from the line, and a four-foot excavation can be made by these machines with ease.

But the laying of the track — the line having been finished at sub-grade with a top width of from 14 to 20 feet for each standard gauge track to be laid — the line begins to assume the appearance of a real railroad. Upon the first stretches of completed track, locomotives and cars employed in construction service begin to operate. As the track grows, their field of operation increases. Then comes the day when the track sections begin to be joined; the railroad is beginning to be a real pathway of steel.

To build this pathway is comparatively a simple matter, once the sub-grade is finished. A mile a day is not too much for any confident contractor to expect of his construction gangs. There was that time, back in '69, when a world's record of ten miles of track laid in a single day was established on the Central Pacific. For that mile of standard track the contractor will need 3,168 ties — eight carloads; 352 rails — five carloads; and a carload of angle irons, bolts, and spikes, as fasteners.

The track-layers are as proud of their profession as any man might be of his. Their skill is a wondrous thing.

Two men who follow the wake of a wagon roughly place the ties as fast as they are dropped upon the right-of-way. Another man aligns them with a line that has been strung by one of the young engineers, a fourth with a notched board, marks the location of one rail. That rail — the line side — follows close to the location marks. It is roughly banded and lightly fastened in place. The other rail — the gauge side — quickly follows. The wonderfully accurate gauge representing the 4 feet, 8½ inches that is almost the standard of the work, and which is tested every morning by the engineers, is in constant use. The railroad track must be true; there is not room for even the variation of a fraction of an inch in the gauge of the two rails.

In fastening the two long lines of rails, the profession of track-laying rises to almost supreme heights. The men who fasten the rail with angle iron and a single roughly-adjusted bolt in each rail-end are head-strappers and past masters in their art. After them in due season come the back-strappers, finishing that fine work of solidly bolting the rail against the vast strain of a thousand-ton train being shot over it at lightning speed. And after the back-strappers and the men who have spiked the rail to the ties, comes the locomotive itself, bringing more ties, more rails, more angle-bars and bolts, and more spikes to the front. Then sometime later the road-bed is ballasted and the line made ready for heavy operation.

But track-laying is frequently machine systematized these days; and in this, as in so many smaller things, the mechanical device has supplanted the man. A real giant is the track-laying machine. It is mounted upon railroad tracks and is a form of overhead carrier with a tremendous overhang. The carrier is fed with the cross-ties from supply cars just back of the machine and the ties are dropped, each close to its appointed place, as a locomotive slowly pushes the entire apparatus forward. In a smaller way the heavy steel rails are de-

:d from under the overhang of the carrier. A gang
en make short work of the fastening of the rail to
ross-ties and the machine moves steadily forward. It
een known to make two miles a day at this work.

ılverts have been laid for each small run or kill or
:; the bridge-builders along the new line finish their
. and cart off their kits; the day comes when there is
nbroken railroad from one end of the new line to
ther. It links new rails and new towns; its localities
nce for new markets, commerce from strange quar-
pours down upon the land that has known it not.
nger trains begin regular operation, the fresh-painted
ts are brilliant in their newness, the shriek of the
notive sounds where it has never before sounded.
fe is awakened. The railroad, which is life, has
ıed forth a new arm, and creation is begun.

CHAPTER IV

TUNNELS

THEIR USE IN REDUCING GRADES — THE HOOSAC TUNNEL — THE OF SHAFTS — TUNNELLING UNDER WATER — THE DETROIT TUNNEL.

SOMETIMES the construction engineer of the road brings his new line face to face with a moun too steep to be easily mounted. Then he may prep to pierce it. Tunnels are not pleasant things thro which to ride. They are, moreover, expensive to struct, and when once constructed are an unending c necessitating expensive and constant inspection. But and that "but" in this case is a very large one — t reduce grades and distances in a wholesale fashion; when you reduce grades you are pretty sure to be ducing operating expenses. A railroad man will th twice in his opposition to a smoky bore of a tunnel will cost some three to five million dollars, when expert advisers tell him that that same smoky bore save him a hundred thousand tons of coal in the co of a year.

From almost its very beginnings the American road has been dependent upon tunnels, and thus closely followed European precedent. The Allegh Portage Railroad, to which reference has already b made, passed through what is said to have been the railroad tunnel in the United States. It pierced a s in the Alleghany Mountains, and it was 901 feet length, 20 feet wide, and 19 feet high within the a 150 feet at each end being arched with cut stone. old tunnel, built in 1832, which has not echoed with *panting of* the locomotive for more than half a cent

is still to be found not far from Johnstown, Pa. It simply serves the purpose to-day of calling attention to the durable fashion in which the earliest of our railroad-builders worked.

Of the building of the Baltimore & Ohio, tunnel-construction formed an early part, several paths being found across the steep profiles of the Alleghanies. The Kingwood Tunnel, which B. H. Latrobe drove, was nearly a mile long and the chief of these bores. But when the Hoosac Tunnel was first proposed — piercing the rocky heart of one of the greatest of the Berkshires — the country stood aghast. Four miles and a half of tunnel! That seemed ridiculous away back in 1854, when the plan was first broached and folk were not slow to say what they thought of such an absurd plan. For twenty years it looked as though these scoffers were in the right — the work of digging that monumental tunnel was a fearful drain on the treasury of the commonwealth of Massachusetts, which was lending its aid to the project. But the tunnel-diggers finally conquered — they almost always do — and the Hoosac remains to-day the greatest of all mountain tunnels in America. The system of continuous tunnels, by which the Pennsylvania Railroad recently reached its terminal in New York, stretches from Bergen Hill in New Jersey to Sunnyside, Long Island, a distance of some ten miles. In fact the largest feature of recent tunnel-work in this country has been in connection with terminal and rapid-transit development in the larger cities. For a good many years New York and Baltimore, in particular, have been pierced with these subsurface railroads; it is a construction feature that increases as our great cities themselves increase. No river is to-day too formidable to be conquered by these underground traffic routes. A river such as the Hudson or the Detroit may sometimes halt the bridge-builders; it has but slight terror for the tunnel engineers.

The tunnel-work is apt to be a separate part of the

work of building a railroad. It calls for its own talent, and that of an exceedingly expert sort. If the tunnel is more than a half or three-quarters of a mile long it will probably be dug from a shaft or shafts as well as from its portals. In this way the work will not only be greatly hastened but the shafts will continue in use after the work is completed as vents for the discharge of engine smoke and gases from the tube. The work must be under the constant and close supervision of resident engineers. The survey lines must be corrected daily, for the tunnel must not go astray. It must drive a true course from heading to heading. In the shafts plumb lines, with heavy bobs, to lessen vibration, will be hung. Sometimes these bobs are immersed in water or in molasses.

From the portals and from the bottoms of the shafts the headings are driven. If the tunnel is to accommodate no more than a single track it will be built from 15 to 16½ feet wide, and from 21 to 22 feet high, inside of its lining; so the general method is first to drive a top heading of about 10 feet in height up under the roof of the bore. The rest of the material is taken out in its own good season on two following benches or levels.

Piercing a granite mountain is no rapid work. When the Pennsylvania Railroad built its second Gallitzin Tunnel in 1903, 13 men, working 4 drills in the top heading, were able to drill 16 holes, each 10 feet deep, in a single day. The engineers there figured that each blast removed twenty-three cubic yards of the rock. At night, when the "hard-rock men" were sleeping and their drills silent, a gang of fourteen "muckers" removed the loosened material.

Slow work that. The Northern Pacific finding its way through the crest of the Cascade Mountains by means of the great Stampede Tunnel, nearly two miles in length, demanded that the contractor work under pressure and make 13½ feet of tunnel a day. The contractor, working under the bonus plan, did better. With his army of

350 "hard-rock men," "muckers," and their helpers, and his tireless battery of 36 drills he sometimes made as high as eighteen feet a day from the two headings. On a three-year job he beat his contract time by seven days. The Northern Pacific paid the price, $118 for each lineal foot of tunnel. That was a high price, occasioned largely by the fact that the work was carried forward in what was then an almost unbroken wilderness. The Wabash finding its way through the great and forbidding hills of Western Pennsylvania to Pittsburgh a dozen years later was able to dig its succession of tunnels at an average cost of $4,509 for 100 feet. Of that amount $2,527 went for labor; and $260 was the price of a ton of dynamite.

When the tunnel engineer finds that his bore is not to pierce hard-rock, of whose solidity he is more than reasonably assured, he prepares to use cutting-shields. These shields, proceeding simultaneously from the portals and from the footings of the shafts, are steel rings of a circumference only slightly greater than that of the finished tunnel. With pick and with drill and dynamite, they constantly clear a path for it, whereupon it is pressed forward in that path. Dummy tracks follow the cutting-shield; and dummy locomotives — more likely electric than steam in these days — are used in removing the material. Electricity has been a boon to latter-day tunnel-workers. Its use for light and power keeps the tunnel quite clear of all gases during the work of boring.

In rare cases, the rock through which the shield has been forced is strong enough to support itself; in most works the engineers prefer to line the bore, with brick and concrete, as a rule. This lining is set in the path of the cutting-shield before its protection is entirely withdrawn; and so the heavy roof-timbering which was formerly a trade-mark of the successful tunnel engineer is no longer used.

Tunnel-boring becomes doubly difficult when the rail-

road is to be carried under a river or some broad arm of the sea. Men work in an unnatural environment when they work below the surface of great waters, and the record of such work is a record of many tragedies. At any instant firm rock may cease, silt or sand or an underground stream may make its appearance and the helpless workmen find a ready grave. In work where there is even the slightest expectation of such a contingency the air-lock, with its artificial pressure to hold back the soft earth and moisture is brought into use. In another chapter we shall see how the caisson is operated. Suffice it to say now that the necessity of " working under the air," brings no comfort to any one. It vastly hinders and complicates the work of construction, and adds greatly to the expense. Moreover, it has its own record of tragedies. Still it remains, to the infinite credit of a national persistence, that there is no record in the annals of American engineering where the workers have finally given up a tunnel job. Lives have been sacrificed, good-sized fortunes swept away, but in the end the resistless railroad has always found its underground path.

The tunnel-workers can tell you of the accident when the subway was being driven under the East River from Manhattan to Brooklyn, three years ago. The cutting-shield, which was advancing from the Brooklyn side, suddenly slipped out from the rock into the unprotected soft mud of the river bottom. The heavily compressed air shot a geyser straight up to the surface of the river some fifty feet above. A workman shot through the geyser, pirouetted gayly for a fraction of a second above the river, then dropped, to be picked up by the crew of a passing ferryboat. In a week he was back at work again inside the cutting-shield. His fortune was the opposite of that which generally awaits a man caught in a tunnel accident.

" It ain't as bad as it used to be," one of them informs you. " When I first got into this profession, they did n't have the electricity for lights or moving the cars or noth-

"Sometimes the construction engineer . . . brings his line face to face with a mountain"

Finishing the lining of a tunnel

THE BUSIEST TUNNEL POINT IN THE WORLD — AT THE WEST PORTALS OF THE BERGEN TUNNELS, SIX ERIE TRACKS BELOW, FOUR LACKAWANNA ABOVE

THE HACKENSACK PORTALS OF THE PENNSYLVANIA'S GREAT TUNNELS UNDER NEW YORK CITY

ing. We used to try and get along with safety lamps an' near choke to death. It was more like hell then than it is now."

But your interest in the man who was blown from the tunnel to the surface of the river and escaped with his life is not entirely satiated, and you ask more questions. What do they do when they strike soft mud like that?

"We get down and pray," he of the experience in this weird form of construction engineering tells you. "We try to get the boys safely back through the air-lock, and then we quit boring till we can fix things up from outside. If it 's a real bad case we 've got to make land to bore through. It 's generally done by dumping rock and bags of sand from floats just over where she blows out. It 's a pretty rough way of doctoring her up, but it has to go, and generally it does. All we want is to get it to hold until we can set the rings of the tunnel.

"That ain't always the worst. I 've been driving a bore under water this way, when we struck stiff rock overhead and soft mud underneath the edge. That 's something that makes the engineers hump. You can't rest a cast-iron tunnel like this on mud and you get a wondering if you 've got to quit after all this work under the durned old river, and let the boss lose his money.

"The last time we struck a snag of that sort, the boss did n't give up. He was n't that kind. He had a chief engineer that was brass tacks from beginning to end. What do you suppose that fellow did? He bored holes in the bottom of the lining and drove steel legs right down to the next ledge of solid rock below. There 's that tunnel to-day, carrying 32,000 people between five and six o'clock every night perched down there seventy feet underground like a big caterpillar sprawled under the wickedest ledge o' rock you ever see."

It takes a real genius of an engineer for this sort of work. He who drives his bore into the unknown must be on guard for the unexpected. Emergencies arise upon

the minute, and the tunnel engineer must be ready with his wits and ingenuity to meet them. Finally the day does come when the bores from either shore are hard upon one another. If there has been blasting under the bed of the river it is reduced to a minimum. The drills work at half-speed, the fever of expectancy hangs over the men. Those who are close at the heading catch faint sounds of the workmen on the other side of the thin barrier — the last barrier of the river that was supposed to acknowledge no conqueror.

The first tiny aperture between the two bores is greeted with wild cheers. On the surface far above, the whistles of the shaft-houses carry forth the news to the outer world; it is echoed and reëchoed by the noisy river craft. The aperture grows larger. It is large enough to permit the passage of a man's body; and a man, enjoying fame for this one moment in his life, crawls through it. The men knock off work and have a rough spread in the tunnel. At night the engineers and contractors banquet in a hotel. "Not so bad," the chief engineer says quietly. "We were ⅜ of an inch out, in 8,000 feet." It was not so bad. It spoke wonders for his profession. To carry forth two giant bores from the opposite sides of a broad river, and have them meet within ⅜ of an inch of perfect alignment, was an achievement well worth attention.

After that, the last traces of the rough rock and silt are removed, the iron rings of the tunnel made fast together, the air pressure released, the cutting-shields, that formed so essential a feature of the construction, removed. Then there remains only the work of installing conduits and wiring and laying the tracks before the tunnel is ready for the traffic of the railroad.

The Michigan Central has recently finished a tunnel under the busy Detroit River, at Detroit, which eliminates the use of a car-ferry at that point. The tunnel

was built in a manner entirely new to engineers. The river at Detroit is about three-quarters of a mile wide, and its bed is of soft blue clay, making it difficult to bore a tunnel safely and economically. To meet this obstacle a new fashion of tunnel-building was created.

The tunnel itself consists of two tubes, each made from steel ⅜ of an inch in thickness and reinforced every twelve feet by outer "fins." The channel was dredged and a foundation bed of concrete laid. The sections of the tunnel, each 250 feet long, were then put in position one at a time. The section-ends were closed at a shore plant with water-tight wooden bulkheads. They were then lashed to four floating cylinders of compressed air and towed out to position. After that it was merely a matter of detail to drop the sections into place, pour in more concrete and make the new section fast. The wooden bulkheads next the completed tube were then removed and the structure was ready for the track-layers. The subaqueous portion of the new Detroit Tunnel is 2,600 feet long; it joins on the Detroit side with a land tunnel 2,100 feet long, and on the Canadian side with a land tunnel of 3,192 feet.

It takes more than a river, carrying through its narrow throat the vast and growing traffic of the Great Lakes — a traffic that is comparable with that of the Atlantic itself — to halt the progress of the railroad.

CHAPTER V

BRIDGES

BRIDGES OF TIMBER, THEN STONE, THEN STEEL — THE STARUCCA VIADUCT — THE FIRST IRON BRIDGE IN THE U. S. — STEEL BRIDGES — ENGINEERING TRIUMPHS — DIFFERENT TYPES OF RAILROAD BRIDGE — THE DECK SPAN AND THE TRUSS SPAN — SUSPENSION BRIDGES — CANTILEVER BRIDGES — REACHING THE SOLID ROCK WITH CAISSONS — THE WORK OF "SAND-HOGS" — THE CANTILEVER OVER THE PEND OREILLE RIVER — VARIETY OF PROBLEMS IN BRIDGE-BUILDING — POINTS IN FAVOR OF THE STONE BRIDGE — BRIDGES OVER THE KEYS OF FLORIDA.

WHEN the habitations of man first began to multiply upon the banks of the water courses, the profession of the bridge-builder was born. The first bridge was probably a felled tree spanning some modest brook. But from that first bridge came a magnificent development. Bridge-building became an art and a science. Men wrought gigantic structures in stone, long-arched viaducts, with which they defied time. Then for two thousand years the profession of the bridge-builder stood absolutely still.

With the coming of the iron and steel age it moved forward again. The development of a fibre of great strength and without the dead weight of granite gave engineers new possibilities. They began in simple fashion, and then they developed once again, with marvellous strides. Steel, the dead thing with a living muscle, could span waterways from which stone shrank. Steel redrew the maps of nations. Proud rivers at which the paths of man had halted, were conquered for the first time. Routes of traffic of every sort were simplified; the railroad made new progress; and economic saving of millions of dollars was made to this gray old world.

The earliest of the very distinguished list of American bridge-builders erected great timber structures for the highroads and the post-roads. Some of them went back many centuries and came to the stone bridge, in many ways the most wonderful of all the artifices by which man conquers the obstructive power of a running stream. But the building of stone bridges took time and money, and time and money were little known factors in a new land that had begun to expand rapidly.

So at first the railroad followed the course of the highroad and the post-road, and took the timber bridge unto itself. In some cases it actually fastened itself upon the highroad bridge, as at Trenton, N. J., where a faithful wooden structure built by Theodore Burr in 1803 was strengthened and widened in 1848 to take the first through railroad route from New York. It continued its heavy dual work until 1875 when it was superseded by a steel bridge. A dozen years ago the railroad tracks were moved from that structure to a magnificent and permanent stone-arch built near-by. Thus the railroad crossing the Delaware at Trenton has, in this way, typified step by step every stage of the development of American bridge-building.

The timber bridges developed the steel truss bridge, the typically American construction, of to-day. In an earlier day the timber bridges were the glory of the engineer. Sometimes you see one of these old fellows remaining, like the long structure that Mr. Walcott built across the Connecticut River at Springfield, Mass., in 1805, and which still does good service; but the most of them have passed away. Fire has been their most persistent enemy. Within the past two years fire destroyed the staunch toll-bridge at Waterford on the Hudson, just above Troy. The bridge was a faithful carrier for one hundred and four years. In many ways it was typical of those first constructions. It consisted of four clear arch spans — one *154 feet, another 161* feet, the third 176

[illegible] and the [illegible] in length. It was b
[illegible] yellow pine, [illegible] and [illegible] hung upo
[illegible] and were for the removal of some of the arc
[illegible] the east and the side openings. It was unc
through all the years — even though the heavy
[illegible] of a through interurban line were finally
upon it.

About the same time the once-famed Per
Bridge across the Schuylkill River at Philadelph
built. It had two arches of 150 feet each and
195 feet. In its day it was regarded as nothing le
a triumph. A very old publication says:

"The plan was furnished by Mr. Timothy Palmer, o
Newburyport, Mass., a self-taught architect. He brought wi
five workmen from New England. They at once evin
great intelligence and adroitness in a business which was
to be a peculiar art, acquired by habits not promptly gai
even good workmen in other branches of framing in wood.
The frame is a masterly piece of workmanship, combining
principles that of king-post and braces or trusses with thos
stone arch."

In after years, the Permanent Bridge was als
trusted with the carrying of a railroad. It has, how
disappeared these many years.

The early railroad builders did not neglect the p
bilities of the stone bridge. Two notable early exan
of this form of construction still remain — the Starr
Viaduct upon the Erie Railroad, near Susquehanna,
and an even earlier structure, the stone-arch bridge ac
the Patapsco River at Relay, Md., which B. H. Latr
the most distinguished of all American railroad engine
built for the Baltimore & Ohio Railroad, in 1833.
The Thomas Viaduct, as it has been known for th
quarters of a century, was the first stone-arch bridge
built to carry railroad traffic. It was erected in a day w
the railroad was just graduating from the use of te

of horses as motive-power. In this day, when locomotives have begun to reach practical limits of size and weight, that viaduct is still in use as an integral part of the main line of the Baltimore & Ohio. It is built on a curve, and consists of 8 spans of stone arches, 67 feet 6 inches, centre to centre of piers, which, together with the abutments at each end, make the total length of the structure 612 feet. It is in as good condition to-day as upon the day it was built.

When the Erie Railroad was being constructed across the Southern Tier counties of New York in 1848, its course was halted near the point where the rails first reached the beautiful valley of the Susquehanna. A side-valley, a quarter of a mile in width, stretched itself squarely across the railroad's path. There was no way it could be avoided, and it could be crossed only at a high level. For a time the projectors of the Erie considered making a solid fill, but the tremendous cost of such an embankment was prohibitive. While they were at their wits' ends, James P. Kirkwood, a shrewd Scotchman, who had been working as a civil engineer upon the Boston & Albany, appeared. Kirkwood spanned the valley with the Starucca Viaduct, one of the most beautiful bridges ever built in America. He opened quarries close at hand and by indefatigable energy built his stone bridge in a single summer. It has been in use ever since. The increasing weight of its burdens has never been of consequence to it, and to-day it remains an important link in a busy trunk-line railroad. It is 1,200 feet in length and consists of 18 arches of 50 feet clear span apiece.

But stone bridges even then cost money, and so the timber structure still remained the most available. Many men can still remember the tunnels, into whose darkness the railroad cars plunged every time they crossed a stream of any importance whatsoever. They have nearly all gone. The wooden bridge was ill suited to the ravages of weather and of fire — ravages that were quickened by

the railroad, rather than hindered. A substitute material was demanded. It was found — in iron.

The first iron bridge in the United States is believed to be the one erected by Trumbull in 1840 over the Erie Canal at Frankfort, N. Y. Record is also held of one of these bridges being built for the North Adams branch of the Boston & Albany Railroad, in 1846. About a year later, Nathaniel Rider began to build iron bridges for the New York & Harlem, the Erie, and some others of the early railroads. His bridges — of the truss type, of course, that type having been worked out in the timber bridges of the land — were each composed of cast-iron top-chords and post, the remaining part of the structure being fabricated of wrought-iron. The members were bolted together. Still, the failure of a Rider bridge upon the Erie in 1850, followed closely by the failure of a similar structure over the River Dee, in England, influenced officials of that railroad to a conclusion that iron bridges were unpractical, and to order them to be removed and replaced by wooden structures. For a time it looked as if the iron bridge were doomed. That was a dark day for the bridge engineers. A contemporary account says:

"The first impulse to the general adoption of iron for railroad bridges was given by Benjamin H. Latrobe, chief engineer of the Baltimore & Ohio Railroad. When the extension of this road from Cumberland to Wheeling was begun, he decided to use this material in all the new bridges. Mr. Latrobe had previously much experience in the construction of wooden bridges in which iron was extensively used; he had also designed and used the fish-bellied girder constructed of cast and wrought-iron."

Under the influence of the really great Latrobe, an iron span of 124 feet was built in 1852 at Harpers Ferry. In that same year, the B. & O. built its Monongahela River Bridge, a really pretentious structure of 3 spans of 205 feet each, and the first really great iron railroad *bridge in all* the land. The path was set. The conquest

of iron over wood as a bridge material was merely a problem of good engineering. The iron bridge quickly came into its own. The Pennsylvania Railroad began building cast-iron bridges of from 65 to 110 feet span at its Altoona shops for the many creeks and runs along the western end of its line. The other railroads were following in rapid order. Squire Whipple, Bollman, Pratt — all the others who could design and build iron bridges — were kept more than busy by the work that poured in upon them.

And in the day when the iron bridge was coming into its own, Sir Henry Bessemer, over in England, was bringing the steel age into existence, first making toy cannon models for the lasting joy of Napoleon III, and then making a whole world see that steel — that dead thing with the living muscle — was no longer to be limited for use in tools and cutting surface. Steel was to become the very right-hand of man. And so steel came to the bridge-builders, at first only in the most important wearing points such as pins and rivets, finally to be the whole fabric of the modern bridge. The transition was gradual. The early engineers began using less and less of cast-iron and more and more of wrought, until they had practically eliminated cast-iron as a bridge material. Then there came a quick change; there was another dark day for the railroad bridge engineers of America. In 1876 — that very year when the land was so joyously celebrating its Centennial — a passenger train went crashing through a defective bridge at Ashtabula, Ohio. There was a great property loss — thousands and thousands of dollars, and a loss of lives that could never be expressed in dollars. An outraged land asked the bridge-builders if they really knew their business.

Out of that Ashtabula wreck came the scientific testing of bridges and bridge materials, and the abolition of the rule-of-thumb in the cheaper sorts of construction. Out of that miserable wreckage came also the use of steel in

the railroad bridge. Steel had found itself; and how the steel bridges began to spring up across the land! They spanned the Ohio, and they spanned the Mississippi, and they spanned the Missouri; a great structure threw itself over the deep gorge of the Kentucky River. When the day came that fire destroyed the famous wooden viaduct of the Erie over the Genesee River at Portage, N. Y. (you must remember the pictures of that tremendous structure in the early geographies), steel took its place.

All this while the bridge engineer attempted more and more. He built over the deep gorge of the Niagara. He conquered the St. Lawrence in and about Montreal. He laughed at the mighty Hudson and flung a dizzy steel trestle over its bosom at Poughkeepsie. He built at Cairo, at Thebes, and at Memphis, on the Mississippi, and again and again and still again at St. Louis. The East River no longer halted him or compelled him to resort to the alternative of the very expensive types of suspension bridge. He has finally thrown a great cantilever over it, from Manhattan to Long Island. The steel bridge has come into its own.

Let us study for a moment the construction of the different types of railroad bridge. For the tiny creeks — the little things that are mad torrents in spring, and run stark-dry in midsummer — where they cannot be poured through a pipe or a concrete moulded culvert, the simplest of bridge forms will suffice. And the simplest of bridge forms consists of two wooden beams laid from abutment to abutment and holding the ties and rails of the track-structure. As the first development of that simplest idea comes the substitution of steel for wood, giving, as we have already seen, protection against fire and a far greater strength. The steel beam has greater strength than a wooden beam of the same outside dimension and yet in its design it effects for itself a great saving

of material, by cutting out superfluous parts and becoming the structural standard of to-day, the I beam. When the I beam becomes too large to be made in a single pouring or a single rolling, it may be constructed of steel plates and angles firmly riveted together, and thus still remains the possibility of the simplest form of bridge. That single span may be further increased, or the bridge developed into a succession of increased spans by the substitution of the lattice-work girder, effecting further saving in weight without material loss of strength for the solid-plate girder. The track may be laid atop of such girders or — to save clearance in overhead crossing — swung between them at their bases.

The limit in this form of bridge is generally in a 65-foot or a 100-foot span. It is not practical to build the girders up outside of a shop; and the 65-foot length represents the two flat-cars that must be used to transport any one of them to the bridge location. Some railroads have used three cars for the hauling of a single girder, and so increased these spans to 100 feet; but as a rule, over 65 feet, and the truss, the most common form of railroad bridge in this country, comes into use.

The truss is a distinct evolution from those old timber bridges of which we have already spoken. Burr and Latrobe and Bollman and Howe and Squire Whipple — those distinguished engineers of other days — have evolved it, step by step. It is, in one sense, no more than an enlarged form of lattice girder, the work of the different designers having been to accomplish at all times, a maximum of strength with a minimum of weight. It is built of members that stand pulling-strain, and those that stand pressure-strain; and these are respectively known as tension and as compression members. In them rests the real strength of the truss. But in addition to the structure are the bracing-rods, generally placed as diagonals and built to sustain the structure against both lateral and wind-strains. The members that form the trusses are

stoutly riveted together; the rapid rat-a-tap-tap of the riveter is no longer a novelty in any corner of the land. Sometimes certain of the important bearing-points are connected by steel pins instead of rivets — another survival of the old days of the timber bridge.

As a rule, the railroad is carried through the truss — and this is known as the through span. Sometimes it is carried upon the top of the structure, and then the truss becomes known as a deck span. A long bridge may effectively combine both of these types of span. The splendid new double-track truss bridge recently built by the Baltimore & Ohio Railroad over the Susquehanna River between Havre-de-Grace and Aiken, Md., to replace a single-track bridge in the same location, is a splendid example of the best type of such structures. At the point of crossing, the river is divided into channels by Watson Island; the width of the west channel being approximately 2,600 feet and that of the east channel being approximately 1,400 feet. The distance across the low-lying island is 2,000 feet — making the length of the entire bridge about 6,000 feet. The bridge, as originally constructed when the line from Baltimore to Philadelphia was built, in 1886, had a steel trestle over Watson Island. In building the new structure, this viaduct was eliminated in favor of a bridge structure of 90-foot girder spans, placed upon concrete piers. Additional piers were placed in the west channel, shortening the deck spans from 480 to 240 feet; the through span over the main channel was kept at the original length — 520 feet. In the east channel, the span lengths remained unchanged, with a single slight exception. The changes in the span lengths involved new masonry, and all piers were sunk to solid rock, those in the west channel being carried by caissons to a depth of more than seventy feet beneath low-water. The total amount of new masonry and concrete approximated 62,000 cubic yards. The long span-lengths of the deck span over the east channel and the through span over

the navigable portion of the west channel — each 520 feet in length — occasioned heavy construction. The deck span, for instance, weighed 12,000 pounds to each foot of bridge. The total weight of this very long bridge reaches the enormous figure of 32,000,000 pounds. And yet, even the untechnical observe the extreme simplicity of its lines of construction, and feel that the engineer, A. W. Thompson, has done his work well. The construction of the giant took two years and a half. During that time, the trains of the B. & O. were diverted to the closely adjacent Pennsylvania, so that the bridge-builders might continue with a minimum of delay.

The truss span reaches its limitations at a little over 500 feet in length — we have just seen how the Susquehanna structure had its spans cut in halves in the non-navigable portions of the river. The spans of two great railroad bridges over the Ohio at Cincinnati reached 519 and 550 feet, but they were built in a day when the weights of locomotives and of train-loads had not yet begun to rise. Nowadays the shorter span is the safer and by far the best. The engineer builds plenty of mid-stream piers, looking out only for a decent width for any navigable channels.

And when because of peculiarities of location he cannot place his pier midstream, then it is time for him to get out his pencils and begin his drawings all over again. He can perhaps build a suspension bridge — a clear span of 1,500 feet will be as nothing to it,— but suspension bridges take a long time to build and are fearfully expensive in the building. It is more than likely, then, that he will turn to the cantilever. In the cantilever, two giant trusses are cunningly balanced upon string supporting towers. They are constructed by being built out from the towers, evenly, so that the balance of weight may never be lost for a single hour. The two projecting arms are finally caught together in mid-air and over the very centre of the span — caught and made fast by

the riveters. The result is a bridge of surpassing strength and fairly low cost, a real triumph for the bridge engineer.

The first of these cantilever bridges built in the United States was of iron. It was designed and constructed by C. Shaler Smith across the deep gorge of the Kentucky River in 1876–77. Mr. Smith also built the second cantilever, the Minnehaha, across the Mississippi, at St. Paul, Minn., in 1879–80. The third and fourth were the Niagara and the Frazer River bridges built in the early eighties. In their trail came many others — one of the most notable among them being the great Poughkeepsie Bridge.

We are going to see something of the construction of one of these great railroad bridges. Let us begin at the beginning, and see the men, as they work upon the foundations of abutments and of piers — many times hundreds of feet under the waters of the very stream that they will eventually conquer. For months this important work of getting a good foothold for the monster will go forth almost unseen by the workaday world — by the aid of the great timber footings, which the engineer calls his caissons. These caissons (they are really nothing more or less than great wooden boxes), are slowly sunk into the sand or soft rock under the tremendous weight of the many courses of masonry. They sink to solid rock — or something that closely approximates solid rock.

We are going down into one of the caissons that form the foothold of a single great pier of a modern railroad bridge; we are going to stand for a very few minutes under air-pressure with the "sand-hogs" — men whom we first came to know when we studied the boring of a tunnel. Air pressure spells danger. It takes a good nerve to work high up on the exposed steel frame of some *growing* bridge, but the bridge-builders have air and sun-

light in which to pursue their hazardous work. The sand-hog has neither. He toils in a box down in the depths of the unknown, working with pick and shovel under artificial light and under a pressure that becomes all but intolerable. The knowledge that the most precious and vital of all man's needs — fresh air — is controlled by another, and through delicate and intricate mechanism, cannot add to his peace of mind.

No wonder, then, that it is the highest paid of all merely manual work. The sand-hog working 50 feet below datum is paid $3.50 for an eight-hour day. But 50 feet is but the beginning to these human worms, who burrow deep into the earth. Below it they first begin to divide their day into two working periods. The air begins to count, and men with steel muscled arms must rest. As they approach 80 feet below datum — the engineers' phrase for sea level,— they are working two periods each day of one hour and a half apiece, while their daily pay has risen to $4. There is your rough arithmetical law of sand-hogs. As your caisson goes down so does the length of your working-day decrease; inversely, their air pressures and the pay of the men increase. The cost? The cost leaps forward in geometrical progression. It is the owner's turn to groan this time.

One hundred feet is the limit. At 100 feet the air pressure is more than 50 pounds to the square inch — three additional atmospheres — and the limit of human endurance is reached. The men work two shifts of forty minutes each as a daily portion and the law steps in to say that they must rest four hours between the shifts. They are paid $4.50 for that day's work — which means something more than $4 an hour for the time that they are actually at work in the caisson.

You have expressed your interest in the sand-hog, given vent to a desire to go down into their underworld. You wonder what three pressures is going to feel like. Per-

mission is given and a physician begins examining you. You cannot go into the caisson unless you are sound of heart and stout of body. This is no joking matter. The sand-hogs' rules read like the training instructions for a college football team. No drink, regular hours, simple diet, the donning of heavy clothes after they leave the pressure, constant reëxamination — these rules are inflexible when the caissons go to far depths. By their observance the difficult foundation construction of this new bridge has been kept free from accident — there have been few cases of the "bends" brought to the specially constructed hospital in the bottom of the cavity.

The "bends" sounds complicated, and is, in reality, almost the simplest of human ailments in its diagnosis. A "bubble" of high pressure air works its way into the human structure while a man is in the caisson. When he comes out into the normal atmosphere the bubble is caught and remains. If it is caught near any vital organ that bubble is apt to spell death. Generally the bubbles are caught in the joints — frequently the elbow or the knee — where they cause excruciating pain. Then the specially constructed hospital crowded on the narrow platform formed by the top of the pier, comes into full play. Its sick room is incased in an air-tight cylinder. The man suffering from the "bends," together with physicians and nurses, is put under a pressure that gradually increases until it reaches that of the caisson. After that it is a comparatively simple matter to relieve the bubble and bring the air in the hospital back to a normal pressure.

The path is clear for us to go down into the caisson. A party of sand-hogs, hot and exhausted after forty minutes of work within, come out of the little manhole at the top of the air-lock. We step through the little manhole and into a tiny steel bucket that rests within the air-lock there at the top of the shaft. A word of command — farewell to the bright blue sky overhead — the black manhole cover is replaced. It is suddenly very

CONCRETE AFFORDS WONDERFUL OPPORTUNITIES FOR THE BRIDGE-BUILDERS

THE LACKAWANNA IS BUILDING THE LARGEST CONCRETE BRIDGE IN THE WORLD ACROSS THE DELAWARE RIVER AT SLATEFORD, PA.

THE BRIDGE-BUILDER LAYS OUT AN ASSEMBLYING-YARD FOR GATHERING TOGETHER THE DIFFERENT PARTS OF HIS NEW CONSTRUCTION

THE NEW BRANDYWINE VIADUCT OF THE BALTIMORE & OHIO, AT WILMINGTON, DEL.

dark. A single faint incandescent gives a dim glow in the tiny place.

You are not thinking of that. They are putting the pressure on. You can feel it. Your eardrums feel as if they would break; they vibrate. You must show your distress.

"Pinch your nose and swallow hard," says the man who stands beside you in the bucket.

He stands so close to you that you can fairly feel the pulsation of his heart, but his voice sounds miles away. You swallow hard, the hardest you have ever swallowed, and you pinch your nose. You feel better. The far-away voice speaks again in your ear. "Three atmospheres," is all it says. The caisson shaft is no place for extended conversation. You descend in an express elevator car; in that bucket you just drop. You have all the eerie sensations that a Coney Island "novelty ride" might give you. There is a row of dim incandescents all the way down the smooth side of the shaft, and when you look you forget that this is vertical traction and think of an uptown subway tube as you see it recede from the rear of an express. A final manhole, the gate at the foot of the shaft and you stop abruptly. It seems as if you had almost bumped against the under side of China.

"This is it," says the far-away voice.

A timbered room, not larger than a parlor in a city flat and not near so high. A close and murky place, filled with a little company of men — shadowy humans of a real underworld there under the dull electric glow.

"They 're finding the footing for the shaft," says the voice. "We 're on rock at last at 94 feet."

When the footings are finished and the caisson's edges have ceased to cut its path straight downward, that timbered construction will rest here far below the city for long ages. The sand-hogs will come out of their working chamber for the last time — it will be poured full

of concrete, more solid than rock itself. The air pressure will be withdrawn — there is no longer mud or shifting sand for it to withhold. Then, section by section, the steel lining of the caisson shaft will be withdrawn, while concrete, tramped into place, makes the shaft a hidden monolith 100 feet or so in length. Upon the tops of all these monoliths a close grillage of steel beams will be laid; upon that grillage will be riveted the steel plates and columns of the bridge tower. The great structure is to have sure footing; these giant feet bind and clasp themselves throughout the years against the mighty river that has been conquered and humbled by the work of man.

"You should have been down in one of the boxes when they had to burn torches, before they got the electric light," says one of the bridge engineers. "I worked in one of those that we left under a stone tower of the Brooklyn Bridge. Now we 're almost in clover. They even cool and dry the compressed air before we breathe it."

An order goes aloft over an electric wire, the engineer who sits smoking his pipe on the sun-baked platform of the traveller derrick pulls a lever, and we go slipping up the shaft toward fresh air and freedom only a little less rapidly than we descended it. We do not reach it too quickly. There is a long wait in the air-lock after the lower manhole has closed, while the pressure is being reduced. You begin to worry and you ask your guide as to the delay. Nothing wrong?

He smiles at your timorous question and explains. It would be dangerous to come out from the caisson pressure quickly. He does not want to have to send you to that air-tight hospital with a bad case of the "bends."

"How long in the air-lock?" you ask.

"Fifty minutes," he answers.

Then he explains in more detail. You have been under a pressure of 50 pounds to the square inch — that 's your three atmospheres, and under the rules you must spend fifty minutes in the tiny air-lock. Up to a pressure of 36 pounds you must spend two minutes there for every three pounds of pressure. When you get above that " law of 36 " it is a minute to the pound.

When that manhole cover overhead finally slides open you feel blinded by the light, even though the sun is hidden behind a passing cloud. The air-lock tender reaches down with his arms and gives you a lift up onto his narrow perch.

" Want to be a sand-hog? " he smiles.

" Not yet a while," you answer, in all truth. " Not until every other job is gone."

You are standing aloft, balancing yourself upon tiny planks at the steadily advancing end of the bridge, as it forces itself over a stream of formidable width. Overhead, a gigantic, ungainly traveller, equipped with steel derricks at every corner, is advancing foot by foot as the bridge advances foot by foot. Underneath, through the thin network of planks, of girder and of supporting false work, you can see the surface of the river a full hundred feet below. A steamboat is passing directly beneath you. From your perch she looks like a great yellow bird. Those fine black specks upon her back are the humans who are gathered upon her upper deck.

Whistles call and the derricks groan as they swing the thousands of bridge-members, that are flying together at the beck of the engineer, into their final resting-places. There is the deafening racket of the riveters, here and there and everywhere. There are crude railroad tracks upon the temporary flooring of the bridge deck, and the calls of the dummy locomotives add to the racket. The railroad tracks lead to the shore, to temporary yards

where the bridge materials are assembled as fast as they come from the shops in a city three hundred miles distant.

For, remember that while the sand-hogs were burrowing under the surface of the river to find footholds for this monster, other men were burrowing into the hillsides to find the precious ore for the welding of his muscles. A hundred thousand picks must have fought in his behalf, furnaces blazed for miles before the crude ore became the finished, perfect steel. Of the forging and the rolling of the steel a whole book might be written. It is enough now to say that of the 50,000,000 pounds of steel, every pound was made on honor. The railroad had its inspectors everywhere, but the rolling-mill men held to their formulas for perfect steel, and perfect steel was the result. A slight flaw in the metal, and possibly at some unexpected day, a great catastrophe. The safety of human life was upon the men who forged the steel, and they forged honor into every great girder, into every rod and bolt and plate. This conqueror of the river was a warrior built in honor.

The safety of human life depends upon the men who build this bridge. Study carefully the face of this man who stands beside you, the man who evolved this bridge as a season's work of his restless mind. His face is the face of a man who has high regard for human safety; that factor creeps to the fore as he talks to you. He is telling of the method of constructing the upper works of a bridge of this size.

"We 're getting ahead all the time," he laughs, "and we 're moving rather forward in our construction methods. In an older day we did this work with derricks of a rather simple sort, operated them by small portable steam engines. You can't handle bridge-members — units that are only held down by the clearances of tunnels and the transporting powers of the railroads — that way to-day. We 've nearly half a million dollars tied up here in con*structing-a*ppliances. These steel-boom derricks, travel-

rs, and steel-wire hoists, the compressing engines for ındling the riveters, cost big money.

"Our method? That's a simple enough affair as a ıle. We set up this spindly tower on rails, that we ıll the 'traveller' and it moves backwards and for- ırds over the trusses and the timber falsework that we uild before the steel really begins to be set up. When he steel — the trusses — is up and riveted, then away rith the falsework. Our bridge stands by itself. You an put up a 500-foot span in no time at all by using the ılsework."

You make bold to ask what the engineer does when he river is too deep to admit of falsework. He is quick o answer.

"We generally fall back on a cantilever," he says, with- ut hesitation. Then he begins to tell you about one of he latest of American problems — the new bridge of the Idaho & Washington Northern Railroad, just now being uilt over the Pend Oreille River, Washington. They ould span that narrow cleft only on the cantilever prin- iple, and when they began to balance their cantilever, ıere was not enough room for the back arm. But the ıgineers only chewed off fresh cigars and began forcing eir great span out mid-air. They made the balance placing 600 tons of steel rails on the back-arm. For ery foot the span reached out anew over a so-called bottomless" they added a few more rails. You can nerally trust an engineer in such a time as that.

Look closely now upon the workmen who are fabrica- ıg this giant bridge. Look closely upon them. They e different from those whom we saw toiling in the issons below. Scandinavians may and do toil as sand- ıgs at the bottom of the stream; Lithuanians may mine e ore, and Hungarians roll it into steel; Americans ild upon their toil and erect this bridge. These build- s speak no unfamiliar tongue. They are the product Ohio, the Middle West, the South, the Pacific Coast,

New England; they rise immeasurably superior to other class of labor employed upon the work. So them have been sailors, and their talk has the sa the sea. All of them are men, clear-headed, cool-h true-headed men.

If you come upon them at the noon-hour, spr along the narrow ledge of a single plank you may l pressed by two things — their Americanism and cosmopolitanism. The first of these is writ upon man as you look at him; the second is evident in talk him. This big fellow must have been a sheriff c Montana, and he must have been a sheriff for bad m dodge; his neighbor is talking about his last job, a high cantilever down in Peru. The two side-pa over by the tool-box are just back from India. Am bridge-building talent encircles the world. Here is a who got his first training down on the Nile; his ass has done some mighty big work on the Trans-Sib

These are the men who are building the bridge. little time there will be no advancing ends, finding path from pier-top to pier-top. There will be, inste long and slender path for the railroad; the bridg will have done their work well; a great river will once again been conquered.

The bridge problem is always different, it const has the fascination of variety. That variety will into play at unexpected turns. Once, down in a Colorado cañon, whose walls rose precipitously f thousand-odd feet, and which was all but filled by a and rapid river, the engineers of the Rio Grand Western found absolutely no ledge whatsoever upon w they might rest their rails. They puzzled upon the p lem for a little while, and then they swung a girder br parallel with the river. The bridge was supporte braced girders, that fastened their feet in the walls of *cañon,* hardly wider there than a narrow city house.

railroad has been running over that construction for more than thirty years; it is one of the scenic wonders of the land, and a triumph for the engineer that built it. In constructing the expensive West Shore Railroad up the Hudson River, similar difficulties were experienced south of West Point, and truss bridges were built parallel with the steep river banks to carry the tracks from ledge to ledge. It is not an unusual matter for the construction engineer to spend a quarter of a million dollars to span some deep, waterless gully in the mountains, which could not be filled for more than twice that sum.

Many times, in these days of increasing weight of equipment, it becomes necessary to replace a bridge, without interrupting the traffic. The construction engineer never fails to meet the problem. Years ago, he took Roebling's famous suspension bridge at Niagara Falls, removed the stone towers and replaced them with towers of steel, without delaying a single train; and a little later he took that bridge itself, and substituted a heavy cantilever for it, while all the time a heavy traffic poured itself over the structure. The rebuilder of bridges works like the original builder — with plentiful falsework. He timbers in and around his structure, and then step by step and with exceeding caution removes the old and substitutes the new. An old girder is taken out between trains; before another train of cars shall roll over the structure a new one is ready, temporarily bolted until the riveters can make it fast. It sounds complicated, but it is remarkably simple, under the careful plans of a patient engineer, who has that infinite thing that we call genius.

Sometimes a bold engineer strikes out into a new method, quicker and less expensive than these piecemeal efforts. Of such was the job at Steubenville, O., where a 205-foot double-track span was erected on heavy falsework alongside the old bridge. In a carefully chosen interval between a service of frequent trains, both the old and the new spans — together weighing 1,300 tons —

were fastened together and drawn sideways a distanc
twenty-five feet in one minute and forty seconds.
new span was then in place, and the old one — r
to be dismantled — stood on falsework at the side.
entire job had been accomplished in an interval of se
teen minutes between trains.

That is not unusual. The floating method is sc
times adopted with remarkable success — especially
the case of draw-bridge spans. There the problem c
plicates itself exceedingly, for both the water and the l
highways must be kept open for traffic; yet it is a ma
of record that the Pennsylvania Railroad, operatin
fearfully heavy suburban service in and out of Je
City, recently substituted one draw for another on
Hackensack River Bridge without delaying a single tr

But even in this high noon of the day of steel, the st
bridge holds its own. The big chiefs of railroad c
struction look upon it with favor. Higher priced t
a steel bridge of equal capacity it requires initial outl
But forever after, it represents a saving — a saving chi
in that very important figure, maintenance. A steel bri
requires constant attention and constant expense. A st
bridge requires little of either; and therein lies its stren
in its old age. Engineers point to such structures as
Thomas Viaduct down at Relay, or to the wonderful st
bridges that have stood through the centuries in ol
lands; they bear in mind the constant battle that a s
bridge must make against the ravages of weather
against the sinister thefts of corrosion, and ofttimes t
rule in favor of the oldest type of sizable bridge.

Two things are all-important in the choice between
steel bridge and the arch bridge of stone or concrete. T
first is the accessibility of the quarries. If they are
very near the solid bridge will cost four times that of
of steel and the average American railroad is not abl
spend money in that fashion, even in the hopes of fut

economies in maintenance. If the quarries are close at hand, as they were years ago when Kirkwood built the Starucca Viaduct for the Erie, the cost of a masonry bridge will hardly exceed that of steel trusses, and the concrete structure may cost a little less. Then there comes into play the second consideration. The stone or concrete bridge has tremendous weight, no ordinary foundation work will serve it. If the river bed and banks be of sand or poor earth, the engineer had best give up his hopes of the Roman form of structure. He can build steel towers and trusses on piles of caissons — hardly solid stone piers and abutments and aides.

All these things considered, the stone bridge is still more than holding its own in modern railroad construction. The Boston & Albany Railroad began building these splendidly permanent structures along its lines through the Berkshires more than twenty years ago. More recently both the Pennsylvania and the Baltimore & Ohio have been looking with favor upon this type of bridge. The Baltimore & Ohio has just finished building its massive Brandywine Viaduct, near Wilmington, a splendid double-track structure, 764 feet in length, and composed of two 80-foot, two 90-foot, and three 100-foot arches.

The three great stone bridges that the Pennsylvania has built upon its main line are all four-tracked. Two splendid examples of these span the Raritan River at New Brunswick, and the Delaware at Trenton, New Jersey. The third, spanning the Susquehanna at Rockville, Pa., just north of Harrisburg, is the largest stone bridge in the world. It is over a mile in length, and is composed of 48 arches; 220,000 tons of masonry was employed in its construction.

Concrete viaducts were first employed in interurban electric railroad construction, and latterly they have been brought more to the service of the steam railroad. A splendid example of this very new form of construction exists in the extension of the Florida East Coast Railroad

over the keys and shallow waters of Southern Florida, for seventy-five miles between Homestead and Key West. A considerable portion of the line is over the sea.

The Florida keys are like a series of stepping-stones, leading into the ocean from the tip of the peninsula to Key West. They lie in the form of a curve, the channels separating the islands varying from a few hundred feet to several miles in width. Nearly thirty of these islands were used in the construction of the new railroad. More than fifty miles of rock and earthen embankment have been built where the intervening waters are shallow, but where the water is deeper and the openings are exposed to storms by breaks in the outer reef, concrete arch viaducts have been used. These viaducts consist of 50-foot reinforced concrete arch spans and piers, with here and there a 60-foot span.

There are four of these arch viaducts aggregating 5.78 miles in length. The longest is between Long Key and Grassy Key, 2.7 miles, and is called the Long Key Viaduct; across Knight's Key Channel, 7,300 feet; across Moser's Channel, 7,800 feet, and across Bahia Honda Channel, 4,950 feet. The material of these islands is coralline limestone. In many places the embankment for the roadway is 8 or 9 feet in height, and the roadbed is ballasted with the same material. The result is one of the finest and safest railway roadbeds in the world.

Across the Delaware River at Slateford, Pa., the Delaware, Lackawanna & Western Railroad is building the largest concrete bridge in the world, a few feet longer than the great structure by which the Illinois Central crosses the Big Muddy River and just 100 feet longer than the Connecticut Avenue Bridge, at Washington, D. C. The Lackawanna's bridge is 1,450 feet long, with five arches of 150-foot span, and a number of shorter arches. The track is carried at an elevation of 75 feet above highwater; and to find living-rock as a solid foundation for a structure of so great a weight, the abutments and piers

were carried about 61 feet below the surface of the ground.

With the bridge-builder at his elbow, the railroad constructing engineer hesitates at no river, no arm of the sea, no deep valley, no wild ravine, no cleft in the mountain-side. He calls to his aid the magic of the men who have made this branch of American practical science famous: a feathery trestle appears, as if by magic. Across its narrow edge the steel rails follow their resistless path.

CHAPTER VI

THE PASSENGER STATIONS

EARLY TRAINS FOR SUBURBANITES — IMPORTANCE OF THE TOWERMAN — AUTOMATIC SWITCH SYSTEMS — THE INTERLOCKING MACHINE — CAPACITIES OF THE LARGEST PASSENGER TERMINALS — ROOM FOR LOCOMOTIVES, CAR-STORAGE, ETC. — STORING AND CLEANING CARS — THE CONCOURSE — WAITING-ROOMS — BAGGAGE ACCOMMODATIONS — HEATING — GREAT DEVELOPMENT OF PASSENGER STATIONS — SOME NOTABLE STATIONS IN AMERICA.

THE railroad terminal is the city gate. Without, it rises in the superior arrogance of white granite, as an architectural something. It has broad portals, and through these portals a host of folk both come and go. Within, this city gate is a thing of stupendous apartments and monumental dimensions, a thing not to be grasped in a moment. In a single great apartment — a vaulted room so great as to have its dimensions run into distant vistas — are the steam caravans that come and go. It is a busy place, a place of an infinite variety of business.

In the early morning the train-shed gives the first sign of the new-born day. Before the dawn is well upon the city, the great arcs that run into those distant vistas in wonderful symmetry are hissing and alight, and the first of 500 incoming trains is finding its way into the gloom of the shed. Some few trains have started out with the early mails and the morning papers. The great rush into town is yet to begin.

Even before dawn, a thousand little homes without the city have been awake and fretful. The gray fogs of the night lie low, and lights begin to twinkle, lines of shuffling figures to find their way to the nearest suburban station. It is very early morning when these begin to

pass through the city gate. The earliest suburban trains slip in from the yards and come to a slow, grinding stop beneath the shed. Before the wheels have ceased turning, the first of the workers is off the cars and running down the platform. In fifteen seconds, the platform is black with men.

There are many more of these trains, a great multiplication of men within a little time. Before seven o'clock, the trains begin to increase; to follow more and more closely upon one another's heels. After seven, they come still oftener; two or three of them may stop simultaneously on different tracks under the great vault of the shed; they are heavy with people. There is a constant clatter of engines, stamping and puffing, dragging their heavily laden trains and snapping them quickly out of the way of others to follow. The electric lights under the shed go out with a protesting sputter, and you realize that the day is at hand. This mighty army of those who live without the city walls is flocking in, in an unceasing current now. There is an endless procession from the track platforms; a stream of humans finding its way to the day's work.

Do you want figures so that you may see the might of this army? Binghamton, N. Y., is a city; a little less than fifty thousand persons live there. If the whole population of Binghamton — every man, woman, and child — were poured through the portals of this terminal on any one of six mornings of the week, it would be about equal to this suburban traffic. In a single hour — from seven to eight — 45 trains have arrived under the roof of this shed and discharged their human freight; in the following hour, 64 trains empty another great brigade of the army from without the city walls.

The city gate is indeed a busy place. Its concourse or head platform echoes all day long with the unending tread of shuffling feet; beyond the fence, with its bulletins and ticket-examiners, is the vault of the train-shed, a

thing of great shadows, even in midday. Its echoes are also unending. There seems to be no end of pushing and shoving and hauling among the engines; there must be an infinite stock of trains somewhere without. The human stream flows all the while.

The marvel of all this is that the terminal, which seems so intricate, so baffling, is under the control of one man — a man to whom it is as simple as the ten fingers of his hands. This man is keeper of the city gate. His watch-house is situated just without the big and squatty train-shed. It is long and narrow, glass-lined and sun-filled. Through its windows he keeps track of those who come and go.

"There 's Second Seventeen, with them school teachers coming back from the convention out at Kansas City. Put her in on Twenty-one so 's to give the baggage folks a chance. Them women travel with lots of duds."

These are orders to his assistants and orders in that watch tower are rarely repeated. The assistants are in shirt-sleeves like their chief, for the sun-filled tower is broiling hot. They nod to one another, click small levers, and Second Seventeen — a long train of sleeping-cars coming into the city in the hot moisture of the early June morning — is sent easily and carefully in upon track Twenty-one in the train-shed of the terminal. There you have the explanation of that order that was meaningless to you but a moment ago. Track Twenty-one is nearest the in-baggage room of the station. With two cars, piled roof-high with heavy trunks, the thoughtfulness of the towerman in sending the special upon track Twenty-one will be appreciated by the baggage handlers. A vast amount of manual labor will be saved; and that counts, even upon a cool day.

This keeper of the city gate represents the survival of the fittest, the very cream of his profession. The chances are that he began his railroading off in some lonely way station on a branch line, developed qualities that brought

THE NORTHWESTERN'S MONUMENTAL NEW TERMINAL ON THE WEST SIDE OF CHICAGO

THE UNION STATION AT WASHINGTON

him to the quick and favorable attention of his chiefs, then advanced steadily along the rapid lines of promotion that railroading holds for some men. He is one of three men, who, for certain hours, hold the keeping of the complicated city gate within their own well-drilled minds. The tower is the mind, the brain centre, the ganglion, of that city gate; but the tower is only wondrously mechanical, after all; the mind of the careful towerman is the mind that controls all the mechanism.

To the average traveller, the city gate is a thing that impresses itself upon his mind by its exterior and interior beauty, or its convenience of arrangement. He notes the broad concourses, the ample entrances and exits, the compelling magnificence of the public rooms, the great sweep of the train-shed roof, but beyond that train-shed roof is a tangle of tracks and signals about which he does not worry his busy head. Those tracks and signals represent more truly the station than the mere architectural magnificence of its outer shell. They are a tangle and a maze, apparently, but a tangle and maze that must represent skill and ease in their tremendous operation. They are neither tangle nor maze to the shirt-sleeved men in the tower. They must know each track, each switch-point, each signal as intimately and familiarly as they know the fingers of their hands.

Every mechanical device is employed to simplify the tangle for the comfort of the busy minds that must constantly employ themselves in solving it. In the big watch-tower — the " control " of the terminal — there is a map that is more than map. It depicts in miniature all the tracks and switches and signals that lie without and round-about the tower; but this map shows switches and signals changing as the switches and signals of the train-yard change. It brings the distant corners of the terminal in closer touch with the towermen. In fog or blinding storm, this track model is invaluable — a veritable compass set within the brain of the terminal.

This illuminated map sets upon the best piece of mechanism that has yet been devised for the operation of the terminal yard. It is a long boxed affair, not entirely unlike the box of the old-fashioned square piano, but in this case (the terminal we are watching being of unusual capacity) more than thirty feet in length. This box is the very brains of the terminal. It represents the acme of mechanical condensation. Reduced to its earliest and simplest equivalent — the separate hand operation of a gigantic cluster of switches in a great terminal yard — it would cover a vast area and result in the employment of an army of switchmen. Carelessness on the part of any one member of this army might cause a serious accident. The margin of safety would be very low in such a case.

The first schemes of automatic switch systems eliminated the necessity of employing an army of switchmen. A cluster of levers, in a tower of commanding location, was connected by steel rods with the switches and the signals which protected them. A man in the tower operated this group of levers. In this way, the control of the yard was simplified, and responsibility was placed upon a better paid and better trained man than the average hand switchman. The margin of safety was considerably broadened.

Then came an amendment to that first system. Some genius of a mechanic built an interlocking switch machine, a thing of cogs and clutches, by which a collision in a railroad yard became almost a physical impossibility. In these mechanical interlocking devices the tower levers are so controlled, one by another, that signals cannot be given for trains to proceed until all switches in the route governed are first properly set and locked; and conversely, so that the switches of a route governed by signal cannot be moved during the display of a signal giving the right of way over them. By installation of the interlocking, some of the responsibility is taken by mechanical device from human brain and the margin of safety broadened still further.

This "piano box" represents still further condensa-

tion of the switch and signal control and interlocking devices. The men who designed this particular city gate designed it to accommodate more than a thousand outgoing and incoming passenger trains each twenty-four hours; they had found that the condensations given by earlier systems were not sufficient for their purpose. After bringing several switches, designed to act in concert, upon a single lever, they found that they would have a row of 360 levers. Set closely together these would require a tower about 160 feet long. It is roughly figured that it is not desirable to assign more than twenty of these heavy levers to a single towerman and that meant eighteen men, working at a shift. Moreover, the throwing of a heavy switch half a mile distant from the tower is not a slight manual exercise.

Then the "piano box" — electro-pneumatic — was installed; 150 feet of levers was reduced to 30 feet of small handles hardly larger than faucet handles and quite as easily turned. The control of a great terminal was brought down to three towermen, acting under the direction of their chief, the shirt-sleeved keeper of the city gate.

"We 've got to keep them hustling," he tells you. "There 's the morning express in from New York. She 's heavy this morning. That train over there, coming across the swing-bridge, is the millionaire's special. She 's all club-cars, comes in every mornin' from the seaside. Her wheels 'll stop on the same nick as the express. Watch them both, carefully."

"Is n't it quite a trick handling those trains simultaneously?"

"Not much," a smile fixed itself upon the chief towerman's features, as he fingered his greasy timetable. "Here 's four trains pulling out here simultaneously at 5:40. On top of that we get a Forest Hills local in at 5:39, a Hudson Upper local at 5:40, an Ogontz at 5:42, a Readville at 5:43, all incoming, and pull out two more at 5:43. Ten trains in just four minutes is n't bad, and

we have n't begun to feel the capacity of this terminal yet.

" That is n't all of it. We get the whole thing criss-crossed on us sometimes; and perhaps they 'll put on an extra getting out of here at 5:40, and that 'll bother us a little, for we have regular tracks assigned for all our scheduled trains. If they don't run in the extras on us, or we don't get a breakdown anywhere, it 's pretty plain sailing. Ring off your 10:10, Jimmy."

Jimmy, the assistant at the far end of the tower, touched one of the little handles, a blade on a signal bridge opposite the end of the train-shed dropped, a big locomotive caught the rails instantly and cautiously led a long train of heavy cars out through the intricacy of tracks and switches until it was past the tower, over the " throat " of the yard, and, striking on the main line, was gaining speed once more.

" It 's as easy for him as unbroken rail off in the country," said the chief towerman to me, as he waved salutation at the engineer passing below him.

Then he fell into a detailed and wondrous explanation of the intricacies of the " piano-box " mechanism. On the lower floor of the tower were air condensers, and through the medium of electricity and compressed air heavy switches and signals a half-mile off are worked almost by finger touch. Each switch is guarded by at least one signal, possibly two — home and distant — and these blades show an open or a closed path to the engineer. They are so arranged that normally they stand at danger and in case of breakdown they return by gravity to danger. At night the blades, which in various positions show safety and danger and caution, are replaced by lights — red for danger, yellow for caution, green for safety — according to the present standard rules.

This physiology of the passenger terminal has dwelt so far upon its brain and its nerve structure; the anatomy is

hardly less interesting. Almost every great passenger terminal in America is built upon the head-house plan. In this scheme trains arrive and depart upon a series of parallel tracks terminating within some sort of train-shed. It is the ideal scheme from the standpoint of the passenger, for no stairs or bridges or subways are necessary to reach any track. The tracks are generally laid in pairs, and between each pair a broad platform is built, which is in reality a long-armed extension of a common distributing platform or concourse extending across the head of the tracks. Sometimes these extension platforms are laid on both sides of a single track for greater facility in handling baggage and for the quick unloading of heavy trains.

But in case any number of trains are to be operated through the terminal, the head-house scheme becomes impracticable and an abomination to the operating department. It makes necessary all manner of backing and turning trains and a tremendous amount of energy and time is spent in so doing. So we find the head-house stations — the real terminals of America — for the most part along the seaboard or at the termination of really important railroad routes. They are an expensive luxury at any other point.

At the outer end of the train-shed, its tracks begin to converge. They are in rough similarity to the sticks of an open fan and at the handle they are reduced to anywhere from two to eight main tracks, the connections with the through tracks that serve the station. The point of convergence is known to the towerman and all the other workers as the "throat" of the yard. It is by far the most important point of the terminal, and is the usual location of the control tower, with its authority over several hundred switches and signals.

Upon the number of main tracks in this "throat" depends the capacity of the terminal, quite as much as the number of tracks in the train-shed or the size of any other of its facilities. If there are as many as eight tracks in

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has never prevailed in England. Some few attempts have been made in this country to build parallel storage tracks, with the transfer table for an operating arm, but almost every attempt of this sort has been induced by a necessity for unusual economy in land-space. We shall need the turntables as long as we continue to use steam as a motive power, and the early method of grouping storage tracks and radii from the table has never lost its favor with operating officers.

A full-size roundhouse, with a diameter approximating 300 feet, has as its necessary accessories, facilities for coaling the locomotives — several at a time — as well as supplying them with water, sand, and other necessities. Possibly the terminal will be big enough to demand shop facilities for trifling repairs and maintenance of both cars and motive power. A big passenger terminal is a much bigger thing than that gaudy waiting-room in which you sit, whilst your train is being made ready to take you out from the city.

Great as the room assigned to locomotives, greater must be yard-room for car-storage, in rough proportions, as the length of the locomotive to the average train length. It takes something approaching a genius to lay out the car-yards, particularly in the case of passenger terminals, which are almost invariably in the heart of great cities where land values are fabulously high. These yards, in order to earn the appreciation of the men who must operate them, must be easy of access and be of sufficient size to meet the heavy demands that are to be put upon them. To appreciate them, let us consider them in daily use.

The heavy express which has discharged its baggage and passengers in the train-shed is hauled out to the yards by one of the sturdy little switch-engines that are eternally poking their way about the yards. The engine that has pulled it in from the road backs itself down to the roundhouse, without another thought of the train. Its responsibility ended as soon as the run ended in the train-shed.

The engineer simply has to see that his locomotive is carefully put away in the roundhouse; and, on some roads, that his fireman cleans its upper parts before the next run out upon the line. The roundhouse crew is then supposed to take care of the rest of the engine.

In the meantime, the stout little switching-engine has hauled the cars out to the yards, separating the Pullman equipment and placing day-coaches, baggage cars, and the like in a position by themselves. An effort is made to keep the equipment for the heavy through trains reserved, allowance being made for occasional changes for repair and maintenance. In the case of the local and suburban trains, their varying traffic requires varying lengths; and it is possible that two or three of the train-shed tracks contain a supply of extra coaches in order that emergencies of sudden and unexpected traffic may be met.

The yards must afford full facilities for storing and cleaning cars. This last is a thorough operation, compressed air being used in many cases and to great advantage. Within, seats are thoroughly dusted, floors swept, woodwork wiped, while the railroad's pride in the outer appearance of its equipment is shown by the scrupulous care with which a small army of cleaners, ladders in hand, wash down the varnished sides of the coaches. In addition, both coaches and Pullmans must be stocked with linen and ice-water, lighting tanks filled and trucks inspected while in storage yards. Most elaborate provisions are made for the stocking of dining and buffet cars.

Through equipment will rest in the yards from six to twenty-four hours, as an average. The local and suburban trains have a programme of their own, slightly different. The engine that is to make the run will get its train in the first place from the storage yard. It is only a big express run, where the locomotive is privileged to back into the station, to find its train made ready there for it by some *fag* of a switch-engine. The engine that hauls the local *backs its* own train into the station, makes its run out upon

the line, 15, 25, 50 miles, whatever the case may be, and brings the train back into the station. It kicks the cars out, just beyond the cover of the train-shed and while it is hurrying to the turntable the cars are being hastily swept and dusted. An hour will be allowed the engineer to turn his engine and get his coal and water supply, and then he will start out again on his local run. This performance will be repeated one or more times, before the coaches are sent to the yard for thorough cleaning and stocking, and the locomotive housed for a little rest in the programme.

This is not the universal programme, but it is typical. It seems simple; but with the multiplicity of local trains in service, the demands of the regular through traffic, and the special demands that come unexpectedly day after day, that car storage yard has got to be arranged for an economy of operation, as well as with the economy of space in view. Each storage track must be of convenient access and the chances are that a separate tower and interlocking may be set aside for the quick, convenient, and safe operation of the storage yard. In any event, it must be so built as to be worked without interference of any sort on the main line tracks of the terminal.

So much for the terminal, in reference to its operation; now let us consider it for a moment from the standpoint of the passenger. The first point to be considered by the engineers who design it is the point that we have just considered — safety and convenience in operation. A terminal might be, and sometimes is, an architectural triumph and a thing of monumental beauty, but a curse and an extravagance as an operating proposition. The architects, the mural painters, the furniture designers and the like are called in last. It is their province to make the setting for the thing the engineers have already created.

So in considering the terminal station as a building, we must still give ear to the engineer. He must plan for the future, anticipate the number of persons who are to pass through this city's gate fifty years hence, and plan

his concourse, so many square inches for each one of those future users of the terminal. Exits and entrances to the trains must be built in order that incoming and outgoing streams of persons shall not conflict. All these points require careful study. It is possible to design a baggage-room so bad as to make the station all but a failure; a stuffy ticket-office that is almost an impossibility to use under pressure conditions. The good engineer thinks two or three thousand times before he begins the design of a passenger terminal.

The concourse, or head platform, that joins all the different track platforms is the main feature of the terminal building. Upon it some persons congregate preparatory to going through the gates to their trains, and other persons congregate awaiting the arrival of trains — a matter which is carefully bulletined for their convenience. Arriving and departing passengers, with a percentage of idlers, must be accommodated upon it. It must be capacious. Exits to the street should be provided, without the necessity of passing through the station building, and the carriage stand should be close at hand.

The waiting-room will be the monumental and artistic expression of the terminal. It may or may not be a portion of the entrance to the concourse and train-shed, but it is essential that it be conveniently located, that smoking-rooms, women's waiting-rooms, parcel-check, telephone, telegraph, news-stand, and restaurant facilities be close at hand. It is hardly less desirable that the ticket-offices adjoin the waiting-room yet the architect who so places his ticket-offices that the belated traveller has unnecessary delay in purchasing his tickets, will bring down unnumbered curses upon his defenceless head.

The modern station will make provision for numerous railroad offices — be a complete modern office-building in fact, although not emblazoning that in its architectural design — and will have lunch-stand and restaurant facilities, with their necessary addenda of store-rooms, refrig-

erators and kitchens, as complete as those of the largest hotels.

The baggage accommodations deserve a paragraph by themselves. Americans, due to the liberal baggage provisions of our railroads, travel each year with increased impedimenta. Each year the task of the baggage-handlers multiplies. Making room for trunks has come to be an important terminal provision. In the large terminals, this traffic is divided, and in-baggage room receiving from incoming trains and distributing to various forms of city baggage delivery and an out-baggage room receiving and checking baggage for outgoing trains. The in-baggage room is always much the largest, because of the delays that almost invariably hold trunks for a time — short or long — upon their arrival at a terminal.

It is desirable that baggage be handled with as little inconvenience as possible to passengers; and for this reason almost all terminals have subways extending from the "in" and "out" rooms beneath all train-shed platforms and connected with each of these by elevators, large enough to receive a full-sized baggage-truck. In this way annoyance and delay to passengers is minimized. In the case of heavy through trains, where baggage runs unusually heavy, the baggage-cars are frequently detached and switched in upon special tracks that run alongside the baggage rooms.

The passenger terminal must also provide mail and express facilities among these structures, but these, as has already been intimated, are generally apart and quite separate from the passenger facilities. A power plant is another necessity. The buildings must be heated, cars warmed in freezing weather long before the locomotives are attached, ice-machines operated for the station restaurant, power supplied to elevators, dynamos, and lesser mechanisms about the terminal. This is a feature that is not radically different from that of other large commercial structures.

The capacity of a modern railroad is measured by the capacity of its terminals rather than by that of its main line tracks. The railroads were not quick to realize nor to appreciate this fact at the first. It was finally forced upon their attention, and in that way became one of the fundamental principles of American railroad construction and operation.

The terminal became recognized as one of the most efficient possible solutions of the congestion problem, a little more than a quarter of a century ago. It was then that the double-tracking and four-tracking devices were found to measure all out of cost with the relief that was to be derived from them. It was then that the engineers were told to meet the situation with a relief that should be measurably low in cost.

The result of their work has been to put America foremost with her railroad terminals. The engineers have worked against great odds in many cases. The railroads in the beginning took little or no forethought for their terminals. They neglected rare opportunities to buy land for these facilities in the beginning, when the cities were small and the land cheap. They have paid in millions of dollars for this neglect. In some cases, the early railroads had little money to expend upon this city real estate; but in few cases did any of their managers have the gift of prophecy that made them foresee the great cities of to-day or the great tides of traffic they would be called upon to move.

Nor has this phase of the situation improved within recent years. A great railroad rebuilt its passenger terminal in an important city ten years ago and blindly imagined that the increase in facilities would carry it a quarter of a century at the least. To-day it is carrying off the remnants of that station improvement to the scrap-heap and trying to see far enough into the future to build a station that shall last it fifty years at least.

There is not an engineer employed by that railroad

who will assert himself as possessed of the absolute belief that the new station will be adequate for the traffic of a half century hence, if indeed the great spreading palace of steel and marble be in existence at all at that time. All that they will tell you is to point to the fact that another one of America's greatest passenger carriers has doubled its traffic within the past ten years.

"How can we gamble with an unknown future of such dimensions?" they ask you in return.

When the Park Square Station of the Boston & Providence Railroad in Boston and the Grand Central Station in New York were built, in the early seventies, they were the first railroad passenger terminals of size that the country had seen. It was thought that *they* would stand a hundred years as monuments to the genius of the men who designed them. To-day they are both gone, each supplanted by a station that both together might be packed within.

Do you wonder then that railroad operator and engineer alike stand appalled at the tremendous terminal problem that our great cities, growing awesome overnight, are constantly presenting to them?

In the beginning, there were no passenger or freight terminals, nor, indeed, a traffic that demanded them. The passenger cars were apt to be hauled by horses from some downtown depot through the centre of the street to an "outer depot" at the edge of the town where the locomotive replaced the horses. When the cars became heavier, the trains longer and more frequent, the railroads were gradually forced in most cities to remove their rails from the streets and the use of horses was generally abandoned. Still, passengers crossing Baltimore, for some years after the war on their way from the North to Washington, noticed that the trains were broken into cars and drawn one by one by horses across the city, through crowded streets, from one outer railroad station to the

other. A venerable white horse was the switching-engine in the Rochester depot until the beginning of the eighties.

When the passenger traffic on the railroads had become a business of extent — about the middle of the past century — the construction of sizable railroad stations began. The Fitchburg Railroad built its stone fortress at Boston, which still stands and was for many years regarded as a marvel of its sort. Down in Baltimore, the Susquehanna Railroad — afterwards the Northern Central — built Calvert Station, and stanch old Calvert is still a busy passenger gateway of the Monumental City. A few years later the Baltimore & Ohio built Camden Station there and Camden Station was regarded as something rather unusually fine for a number of years.

In the sixties, the railroad terminals grew in size, and the old custom of having separate stations at the far sides of important towns was disappearing, as the American began to see and to demand the advantages of through traffic. So Cleveland built at the close of the war a stone Union Station, of such size that Cleveland folks bragged of it for many years. The stone Union Station at Cleveland is still in use, but the folk of that town do not brag of it nowadays. Cleveland has grown a good deal since they built the Union Station there.

The first real passenger terminals of importance in the country were the Park Square in Boston, and the Grand Central in New York, to which reference has already been made. These presented architectural pretensions such as the railroads of the country had not before offered to the cities they served. They also served as models for bigger things that were to follow. In Boston, the Lowell Road planned and built a large new station, and the era of the passenger terminal was begun.

When the Pennsylvania Railroad built Broad Street Station, at Philadelphia, it built a terminal a little finer than anything accomplished up to that time. Even today, with the dignity of years creeping upon it, Broad

Street is still one of the foremost American stations. The policy of its owners has been to keep it abreast of the demands of the day, and only recently it has been greatly enlarged again, its protecting, interlocking, and signal system being made second to none in the world. To the traveller, the ivory-white waiting-room, where Philadelphians delight to congregate, is an unending source of admiration; engineers find interest in the intricate system of tunnels and bridges by which a number of trunk-line divisions are brought into the station without crossing at level. Broad Street Station shows a yearly increase in its passenger traffic of about five per cent. It has a daily movement of more than 600 loaded trains in and out, in addition to a heavy switching movement. But because of the steady increase of its traffic the Pennsylvania has already planned to relieve it by building a new main station for express trains out at West Philadelphia. When that is done Broad Street will be used exclusively for suburban traffic. A short distance away stands the Market Street Station, of the Philadelphia & Reading Railroad, a terminal rivalling Broad Street in beauty, and only slightly inferior in capacity. Philadelphia possesses two distinguished city gateways.

But the first big station terminals — in our American sense that a thing big must be bigger than anything else of the same kind in the world — were those erected at Boston and at St. Louis. The first of these handles a traffic far exceeding that of any other terminal ever built; the second has a train-shed that is gigantic and overwhelming; and so each of the cities can, in a measure of truth, claim for itself the largest railroad station ever built. Each has enough of novelty and interest to make it worthy of attention.

The Boston terminal — South Station — was preceded by a giant structure erected along the bank of the Charles River to receive a multitude of through and suburban railroad lines entering from the north. This terminal —

North Station — embraced the structure of the Boston & Lowell Railroad and superseded those of the Boston & Maine and Fitchburg railroads. The merging of these and other interests into the present Boston & Maine made the North Station a possibility. It is not a structure of particular distinction, from either an architectural or an engineering standpoint, but it has proved itself a mighty convenience to a travelling public, using a multiplicity of busy lines.

The convenience of it made the South Station a possibility. Boston, like Philadelphia, spreads out well beyond its actual boundaries and measures itself as a vast community, including many near-by cities and villages. With the consolidation of a number of railroads in Southern New England into the New York, New Haven & Hartford system, and the popularity of the North Station so close at hand, the South Station came as a matter of course. It replaced the stations of the New York & New England — whose site forms part of its site — the Old Colony, the Boston & Albany, and the Park Square Station. To accommodate the vast traffic of all these railroads, a great terminal was designed and built, a thing whose bigness is hardly realized by the passenger coming and going through it and who knows it only as a thing of some thousands of shuffling feet, giant shadows, and long distances.

In addition to the 28 sub-tracks in the train-shed, South Station is, in effect, a through station for electric suburban traffic. This service has not yet been installed, but the tracks are ready for use upon short notice, when the facilities of the main train-shed shall become overtaxed. This through station has been ingeniously devised underneath the train-shed and waiting-rooms of the terminal. It is served by two tracks leading from the main entrance tracks to the station — guarded by separate interlocking and tower controls, and consists of two extensive loops.

For suburban service, with no baggage to be handled, these loops will some day afford a great accommodation. Three or four electric trains may be stood upon each. The time and necessity of reversing the trains is entirely obviated, and upon the two tracks of this sub-station a short-haul traffic can be handled almost equal in numbers to that of the train-shed overhead.

What such a statement means can be better realized by a recourse to bold statistics. South Station handled 31,831,390 passengers in 1909, who travelled to and fro in some 800 trains daily. It has handled more than 900 trains in a single day. Its baggage men take care of more than 2,500,000 trunks in a twelvemonth. The statistics of a city gate like South Station are, in themselves, sizable.

St. Louis has one passenger station to serve as city gate for the traffic that comes and goes at that important railroad centre. That gate is the chief through passenger traffic point of the world. From its train-shed one may take through trains to every corner of the United States and a few distant corners of Mexico and Canada. St. Louis, like most Western cities has no volume of suburban traffic as New York, Boston, or Philadelphia, but it is a consequential point for through passengers. The better to serve the needs of the 22 different railroad systems entering that city, the Union Station was built a dozen years ago. It was thought to be big enough to last St. Louis many years. Before the World's Fair of 1904 opened in that city the Union Station was already judged inadequate, and an elaborate plan was consummated for its enlargement.

When the Union Station was originally planned, St. Louis demanded a gate that would be worthy of her size and dignity. No type of through station would do, the head-house terminal was demanded and built, even though in actual practice it necessitated backing each arriving

train into the shed. A station of giant size with the largest train-shed in the world was built and hailed with a glad acclaim by the Western town.

When the station was found inadequate, the engineers found their plans for enlarging it would have to be adapted to a very confined area, proscribed by immovable railroad properties to the south, highway viaducts to the east and west, and a granite head-house, costing several million dollars, to the north. Within that confined area, they were to correct the evils of insufficient capacity — a train-shed with a single 4-track throat and some standing tracks of but 3 cars' length, inadequate baggage arrangements, and lesser evils. Within two years, they had substituted, without increasing the area of the Union Station property, a 10-car capacity for each of the 32 tracks of the train-shed, a double throat with 6 tracks, increased concourses and distributing platforms for passengers, and a complete subway system for the handling of baggage. The prosecution of that work, while the station was in constant and busy use, ranks as one of the marvels of latter-day practical engineering.

From the standpoint of the architect, no other station has yet been built in the United States that can compare with the new Union Station at Washington. For years, the overcrowded railroad stations at that city have been but wretched gateways to the national capitol. Now the city that is fast becoming the Mecca of all Americans has an entrance worthy of her dignity, and in keeping with the increasing magnificence of her architectural works.

The Washington Station is in full accord with the wonderful architectural development of that city, and has a setting in the creation of a great facing plaza, in which 100,000 troops may be gathered in review. Some day the plaza is to be surrounded by a group of public buildings but even in that day the white marble station, exceeding in size all other Washington buildings save the

Capitol itself, will remain the dominating feature of that facing plaza. It has been created in simple classic outline, a vaulted train-shed being purposely omitted, in order that the station should not overshadow the proportions of the near-by Capitol.

Similarly, the vaulted train-shed has been omitted in the splendid new white granite terminal which the Chicago and Northwestern Railway has just completed on the West Side of Chicago. That new terminal is a real addition to a town which has long boasted two model stations — one in La Salle Street and the other upon the Lake Front. The Northwestern terminal is one of the fine architectural features of Chicago — a structure of classic design, the dominating feature of which is a colonnaded portico, monumental in type and towering to a height of 120 feet above the main street entrance.

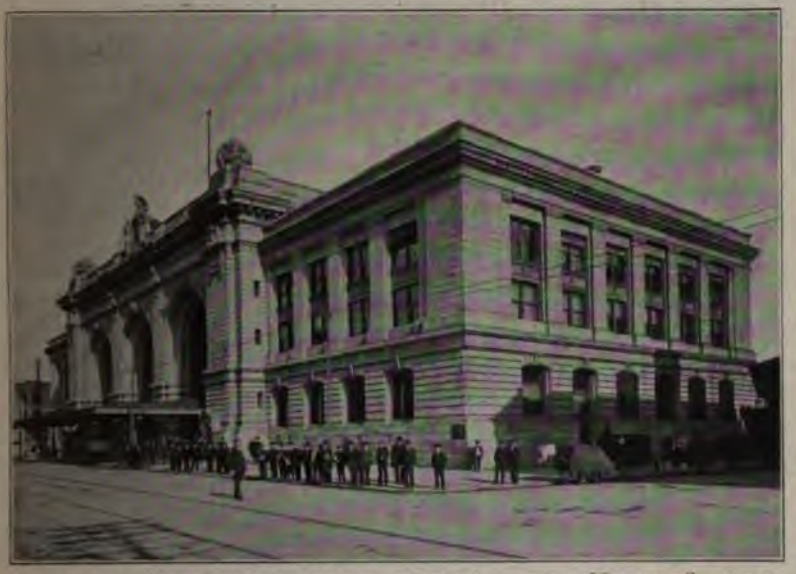
This new terminal has a possible capacity of a quarter of a million passengers each day. It has some novel features for the comfort of passengers. A great many travellers cross Chicago in the course of twenty-four hours; in many cases this is the single break in a weary and dirty journey. For these, the new terminal not only provides the customary lounging rooms and barber shops, but also private baths. There is a series of rooms where invalids, women with children, or other persons seeking privacy, may go directly by private elevator where they may rest while waiting for connecting trains. For women there are tea-rooms and hospital rooms, with trained nurses in attendance. That is almost the last note in comfort for the traveller. There are, in addition to all these, private rooms where the suburbanite may change into his evening clothes and proceed in his various social duties, changing back again before he catches his late train out into the country.

New York City is still in the process of rebuilding and readjusting her gateways. Two magnificent terminals in

her metropolitan district have already been finished; the third is still under construction. The first of these terminals is a real water-gate, built for the Lackawanna Railroad and situated in Hoboken, just across the Hudson River from the corporate New York. It is a handsome architectural creation in steel and concrete. Its tall clock-tower dominates the river front by night and day and those who come and go through its portals find themselves in a succession of white and vaulted hallways and concourses that suggest a library or museum more than the mere commercial structure of a railroad corporation.

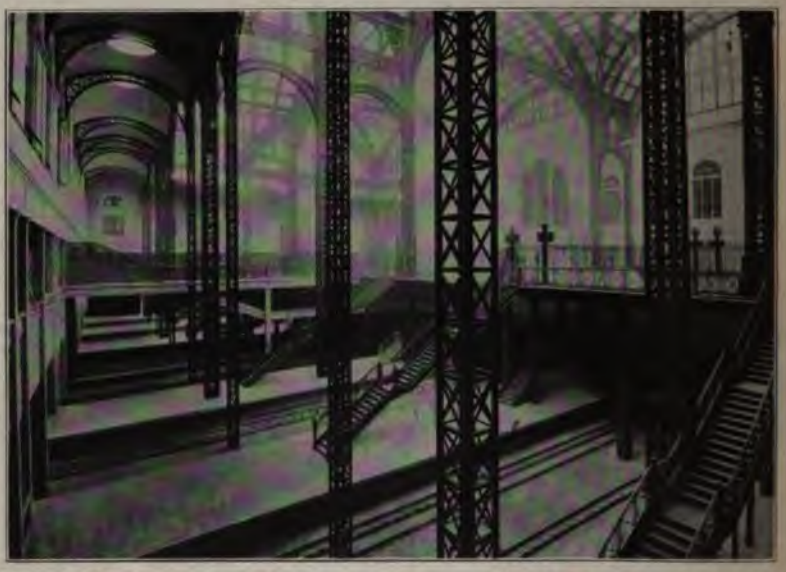
An interesting feature of the Hoboken Station is the abandonment of the high train-shed such as has come to be a distinguishing feature of some of the world's great terminals. Engine smoke and gases work havoc with the structural steel work of such sheds, and the engineers of the Hoboken Station fashioned a low-lying roof, slotted to receive the locomotive stacks. The result is a clean train-house, yet admirably protected from the stress of weather. It is a novel note in terminal engineering.

The Pennsylvania Station, opened in November, 1910, has already become one of the notable landmarks of New York. Beneath it disappeared the biggest hole ever excavated at one time in the metropolitan city; for the great station is not so famed either for its architectural beauty or for the completeness of its details (although it is in the foreguard of the world's great terminals in both of these regards), as for the stupendous engineering project that was found necessary to connect it with the trunk-line railroads that it serves. To the west, this takes form in two parallel tunnels underneath the city, the Hudson River, and the Jersey Heights; to the east a still heavier traffic, composed of empty trains in Pennsylvania service and a great army of Long Island commuters, is carried under the very heart of Manhattan Island and under the East River in four parallel tunnels. Trains run for six miles under the greatest city of the continent, with its



A model American railroad station — the Union Station of the New York Central, Boston & Albany, Delaware & Hudson, and West Shore railroads at Albany

The classic portal of the Pennsylvania's new station in New York



THE BEAUTIFUL CONCOURSE OF THE NEW PENNSYLVANIA STATION, IN NEW YORK

"THE WAITING-ROOM IS THE MONUMENTAL AND ARTISTIC EXPRESSION OF THE STATION," — THE WAITING-ROOM OF THE UNION DEPOT AT TROY, NEW YORK

flanking rivers and environs, without ever seeing more than a momentary flash of daylight. The terminal has no train-shed or other of the familiar external appearances of the usual railroad station in a large city.

The Pennsylvania terminal also departs radically from the other great terminals in its track arrangements. The twenty-one parallel station tracks, with their platforms, are placed in a basement forty feet below street level. In fact, the great building is divided into three levels. At the street level are the broad entrances, the chief of these forming itself into a broad arcade, lined with shops that cater particularly to the demands of the traveller. On this floor are also the railroad's commodious restaurant and lunch-room.

On the intermediate plane, or level, the real business of the passenger prefatory to his journey is transacted. The concourse, the great general waiting-room, with its subsidiary rooms for men and women, the ticket offices, and the telegraph offices are there gathered. From the roomy concourse, covered in steel and glass after the fashion of the famous train-sheds in Frankfort and Dresden, Germany, individual stairs and elevators lead to each of the track platforms. A sub-concourse, hung directly underneath the main structure, is reserved for exit purposes only, and serves to separate the streams of incoming and outgoing passengers. The north side of the station is separated and reserved for the use of the Long Island passengers, chiefly commuters.

The theory of operation of the station is simplicity itself. A Pennsylvania through train from the West, after discharging its passengers and baggage, will not be backed out of the train-house, but will continue on through the station, under more tunnels and another river, to the storage yards just outside of Long Island City. Similarly, trains made ready for a long trip at the yards will proceed empty under the East River tunnels to the big station, where they will receive their outbound load.

This is the theory of the station, an operating theory which makes it in part like a giant way-station and saves much terminal congestion. The Long Island trains and a few short-line Pennsylvania express trains will be turned in the station. These are the exception.

Of interest fully equal to that of the new Pennsylvania Station, is the construction of a new Grand Central Station upon the site of and during the use of the old. The Grand Central Station, used by both the New York Central and the New York, New Haven, & Hartford Railroads, has been for many years New York's great gateway to the east as well as the north and west. It has developed a great suburban and a great through traffic since the construction of the first station — away back in 1871. Temporary relief was gained in the early eighties by the construction of an annex to the east of the original station. Still further improvement was gained ten years ago by tearing out a series of ill-arranged public rooms and substituting for them the single beautiful waiting-room that has proved so great a delight to travellers. Now that waiting-room is about to be demolished in the face of plans for the newer and greater Grand Central.

The building of the new station has offered tremendous problems to the engineers, for it has demanded a complete reconstruction within extremely limited area, while not placing hindrances in the way of the constant operation of one of the world's greatest terminals. Coincident with the rebuilding of the new station has come the substitution of electricity for steam on the terminal lines of its two tenants, the New York, New Haven, & Hartford, and the New York Central & Hudson River Railroads. In order to work the three-mile tunnel through Park Avenue and the sole entrance for trains to the station at greatest capacity, it was found necessary to extend the yards of the new station far north of those of the old. This work, alone, has necessitated the acquisition of whole *city blocks of* tremendously valuable real estate and the

excavation of several million cubic yards of rock and earth.

To accomplish the work of reconstruction and still enable the station to handle its great traffic without serious interruption, serious forethought and definite plans of action were found necessary. The plan was developed by constructing a temporary building of brick and plaster covering a vacant city block in Madison Avenue, at the west of the station. Into this temporary structure a branch post office, an important adjunct of the Grand Central, was moved from the extreme eastern side of the terminal. Excavation for the new terminal began at its eastern edge and at that edge the first portions of the new structure have been completed. A waiting-room was then established in temporary quarters, the last vestiges of the old Grand Central removed, and the main front and centre of the new station fabricated. Similarly, as the excavation has progressed from the east to the west side of the terminal, the great bulk of the traffic has been gradually shifted from the old high-level to the new low-level.

The new Grand Central complete will have its main train-shed devoted to through traffic. A second train-shed of similar arrangement and of slightly smaller dimensions will be constructed underneath the main shed for suburban traffic, and a single head-house will serve both floors. The head-house will have as its chief architectural feature, a concourse of mammoth proportions. The lesser features of the new Grand Central will contribute to make the new terminal, built upon the site of the historic old, one of the world's greatest gateways. The fact that steam locomotives are absolutely prohibited from entering either of the two new stations on Manhattan Island makes these the cleanest railroad terminals yet built.

So not only have our railroads begun to build great stations; they are to-day *building* really beautiful stations.

An age in which the American demands the exquisite and the monumental in his architecture, palatial homes, palatial shops, palatial hotels, demands that the railroad station be something more than the mere expression of a commercial utility. Stone, the sturdy and durable building material of all the ages, has become the expression of these buildings from without. Within, they are gay with rare marbles and mural paintings. There is nothing too fine for the railroad passenger terminal of to-day in the United States.

When the master fancy of the architect, Richardson, designed the splendid stations at Worcester and Springfield, as well as a host of smaller attractive stations along the line of the Boston & Albany Railroad, the beginnings were made. More recently this rising American desire for beauty and good taste has shown itself in such elaborate and artistic structures as the stations at Albany and Scranton. The last step has come in the designing of the palatial terminals in Chicago, in Washington, and in New York City. It would take a bold prophet to anticipate what the next step might be.

CHAPTER VII

THE FREIGHT TERMINALS AND THE YARDS

CONVENIENCE OF HAVING FREIGHT STATIONS AT SEVERAL POINTS IN A CITY — THE PENNSYLVANIA RAILROAD'S SCHEME AT NEW YORK AS AN EXAMPLE — COAL HANDLED APART FROM OTHER FREIGHT — ASSORTING THE CARS — THE TRANSFER HOUSE — CHARGES FOR THE USE OF CARS NOT PROMPTLY RETURNED TO THEIR HOME ROADS — THE HARD WORK OF THE YARDMASTER.

ALL the folk who come and go upon the railroad know the passenger stations. Few of them know the freight terminals. Yet it is from this last source that the railroad will derive the greater part of its revenue. The freight terminals of a large city will be a group of plants, designed for varying purposes. The railroad handles its passenger business from a single structure, if possible. It is comparatively simple to gather all its passengers, even from a broad territory, within a great city, and so to concentrate this part of its traffic in a single well-located terminal.

With the freight it is entirely a different question. The problem of trucking is one of the great problems of each of our large cities, and, in order to eliminate this as far as possible, the railroad, under the stimulus of competition, will establish freight stations at each point where any considerable volume of traffic is likely to originate. These stations will consist of a freight-house, for handling package-freight (your traffic expert calls this "LCL," meaning "less than carload"), and wagon yards for carload lots. Perhaps there will be two freight-houses, one for inbound, the other for outbound traffic. The wagon yards will have to be ample for the accommodation of a

host of trucks and drays as well as for the long rows of freight-cars.

In addition to these stations, each large manufacturing plant is apt to be a freight station of itself, with a private switch running to its shipping-rooms and storage sheds; and in even a moderate-sized American city there may be from 300 to 500 of these sidings in active daily use. So much for the general commodity freight. Then there are the special commodities.

Coal, for instance, is a freight business of itself. It is not handled in the regular stations of the railroad, but in specially designed pockets and storage sheds, which may be located at from one or two to half a hundred different accessible points about the city. One begins to see, after a little while, why the railroads now seize with avidity each opportunity to gain lines through the hearts of our cities. Each line gained means some appreciable relief toward the taking up of a traffic burden that increases yearly.

It is most probable that the freight terminals of the city will have to accommodate much more traffic than that which originates or terminates there. Important lines of other railroads may intersect at that point, and the handling of interchange freight is a busy function of the terminal scheme. It may be an important point for lake, river, or ocean traffic; and in such a case, the industries at docks and docking facilities of every sort form other busy functions. There will be coal or ore wharves, elevators, and car-floats to enter into the scheme.

So you see the railroad's freight terminal in any large city is like the fingers of its extended hand. The long tendons reach into every productive centre, gathering and distributing at from a dozen to fifty points, aside from the private sidings. It is obvious that these must be caught together somewhere; and generally upon the outskirts of an important traffic city the railroad creates an *interchange yard* where this freight, incoming and outgoing —

100 trains a day, perhaps — is gathered together and sorted with system and regularity, very much as the post office sorts the letters and the mail packages.

To examine more closely this working of a modern freight terminal scheme, let us take a single plant of a single system. The great operation by which the Pennsylvania Railroad catches up and delivers its freight in the metropolitan district around New York is typical, and will illustrate.

The Pennsylvania works with at least 24 freight stations, in addition to a great number of private sidings from its lines as they pass through Eastern New Jersey. These stations handle the freight of Manhattan Island, Brooklyn, Jersey City, Hoboken, Newark, and smaller centres; but in addition to them there are vast docks at which foreign steamers berth, lighterage facilities for both foreign and coasting steamers, and a tremendous freight interchange with the railroads running to the north and east. The coal business is there again, a separate institution with many piers and pockets; there is a group of bulky elevators that rise above the smoky, busy Jersey shore, the whole going to make a sizable freight terminal. There are coal pockets, piers, elevators, and a local freight station at Jersey City (the railroad men know it as Harsemus Cove), and another much larger plant at Greenville on the west bank of the upper harbor, almost behind the Statue of Liberty. This last plant is just now awaiting its greatest development. The Pennsylvania Railroad, through its ownership control of the Long Island Railroad, is building an encircling line, 4 and 6 tracks wide, around Brooklyn, and crossing its passenger terminal yards at Long Island City. This encircling line — the New York Connecting Railroad it is called — will be continued by a splendid bridge over the East River to an actual connection with the New Haven system reaching up into New England. When this is done, one of the bugaboos of the freight*men* — *the* slow and ofttimes

dangerous movement of barges and car-floats through the East River, past the entire length of Manhattan Island — will be ended. Greenville will become the distributing point for the bulk of New England freight that comes and goes from the south and the west through New York.

Even at the present time Greenville is a freight point of considerable magnitude. Go out to Waverley, the great sprawling interchange yard that reaches from Newark almost to Elizabeth along the edge of the Jersey meadows, and watch the through trains come from Greenville. They rank well to-day with the traffic that comes from Harsemus Cove already; and Harsemus Cove is soon to be as nothing.

Waverley is more than a mere junction. It was in the first instance the neck of the bottle where the double-track line from Greenville, the main line from Jersey City and Harsemus Cove, and the cut-off freight line that carries through traffic around the heart of great and growing Newark, united to form the main line of the busy Pennsylvania Railroad. Being a gateway by natural location the railroad sought to make it a gateway in reality. A big assorting or classification yard was built there for outgoing freight, and another for the incoming. Storage tracks were added and one of the great transfer houses of the country — but of that, more in a moment.

The business day ends at the many freight-houses along the waterfront of Manhattan and Brooklyn at four o'clock in the afternoon. At that hour, the railroad refuses to accept any more freight for the day, car-doors are closed and sealed with rapidity; in a short time the long and clumsy floats are being hauled by pert little tugs toward Harsemus or Greenville. There is not much loafing at either of those points along about supper-time. Switching crews show feverish activity in snatching the cars from the floats, and yardmasters bend themselves nervously toward forming the long trains that are to go rumbling toward the west throughout the night.

Stand in the switch-tower at Waverley, and you will begin to cultivate a wholesome respect for the freight traffic that comes out from a great city at nightfall. A through train from Greenville is billed to Pittsburgh, and only hesitates long enough at Waverley to take the switch-points at that busy junction with care. Three minutes behind it is a through Chicago train from Harsemus Cove, and it goes stolidly through the gateway yard without pausing. You wonder why they keep an expert yardmaster and half a dozen switching crews at Waverley. Within five minutes you wonder no longer. They are beginning to get the unassorted cars from the terminals, cars that are bound for more than a score of States. The work of sorting begins. The night yardmaster is a general, and he has an army of lesser officers in the field. You can trace them through the night, as, lanterns in hand, they are running along the trains (these are pulling in from the waterfront every five minutes now), cutting out cars, adding cars, vamping and revamping the freight traffic of the night.

This track receives through freight for Philadelphia, the next for Pittsburgh, the third for Cincinnati, the fourth for Washington and the points diverging therefrom. So it goes. When the assorting process has been in progress for more than an hour at one end of the classification tracks, there are long trains of cars upon them ready to run solid to some large city or important distributing point. After that it is a simple enough matter to bring engines and cabooses and start the trains through. Then the sorting of the cars is begun again and continues until the freight receiving points and the freight interchange points in the metropolitan district have been swept clean for the night.

The transfer-house repeats the assorting process, only upon a smaller scale, for it handles package freight — "less than carload." It is a long structure, stretching its way down the yard and served by 8 to 10 long sidings

and unloading sheds. It takes the "LCL" stuff coming by night from the connecting railroads and from the metropolitan freight-houses, and a little after midnight its workers begin the sorting of this great mass of matter, from 200 to 500 carloads a day.

Here is a really great phase of railroad energy. We find our way to a gaunt freight-house, to whose door no truck has ever backed, and which is hemmed in by many rows of sidings and of sheds. In this building one of the busiest functions of the whole transportation business goes forth by day and by night.

You ship a box — sixty pounds to one hundred pounds — from Wilkes-Barre, Pa., to Berlin, Wis. Here comes another box from Watertown, N. Y., to Norfolk, Va. A third is bound from Easthampton, Mass., to Chillicothe, O.; a fourth from Terre Haute, Ind., to Plainfield, N. J., and so on, *ad infinitum*. You can readily see how in such cases the railroads have a problem in freight that closely approximates that of the Government mail service. Ten thousand currents and cross-currents of merchandise rising here and there and everywhere, and crossing and recrossing on their way to destination, make a puzzle that does not cease when the rate-sheet experts have finished their difficult work.

If all the freight might be expressed in even multiples of cars the problem would not be quite so appalling. But your box is a hundred pounds weight, or less, perhaps —"LCL" anyway. From its destination it goes with other boxes in a car to the nearest transfer point. At the transfer house the car in which it is placed is drilled quickly into an infreight track, seals are broken, doors opened, and re-assorting begins. The transfer-house is roomy and systematic. If it were anything less it would resemble chaos.

But the chief freight points of that particular system and its connecting points have regular stands, upon which

nightly are placed cars bound for these points. Each city (in the case of a large city each freight-house), each transfer point, has a number, and its through car stands opposite that number. When the infreight arrives and is unloaded piece by piece, a checker, who is nothing less than an animated guide-book, gives each its proper number, and it is promptly trucked off to the waiting car. It is mail-sorting on a Titanic scale.

Nor is this an absolute order. Certain towns demand an occasional through car from time to time, and a car must be assigned number and place at the transfer-house against such emergencies. Sometimes there is more than enough freight to fill the car allotted to any given point, and then one of the switching crews must drill that out and find another empty to replace it. Beyond that, the yardmaster's superiors are all the time demanding that he show judgment in picking the cars to be filled.

When a freight car gets off the system to which it belongs it collects forfeits from the other lines over which it passes, if they do not expedite its passage; this the railroaders know as "*per diem*." The great trick in operating is to keep *per diem* down; and so the "foreign" cars, so called, must be promptly returned to their home roads.

"We load out of the transfer-house a through car over the Northwestern from Chicago every day," the man who has this yard in charge explains. "It 's up to me to have a Northwestern empty for that when I can. When I can't, I do the best I can." He scratches his head. "Perhaps I 'll use a Canadian Pacific, and so get her started along toward home. If not, something from the Sault; just as I am going to start that New Haven car over toward Connecticut to-night. If I were to send that New Haven car out beyond Washington there 'd be trouble, and I 've got to dig out something empty from the Boston & Maine to take that stuff over to Lowell.

Mos' generally, though, when we 've got a turn of Western stuff, I 've got my ' empty ' tracks stuffed full o' them New England cars."

We mention something about the transfer-house being a mighty good thing.

" It 's a necessary evil," says our guide, correcting us.

He starts to explain. " See here. The X——, over in its Jersey City transfer-house, got near a carload of that fancy porcelain brick through from Haverstraw las' week, and that young whelp of a college boy that 's hangin' round there learnin' the railroad business gets it into his noodle that it 's somethin' awful, awful for that stuff to be goin' through to Middle Ohio in a Maine Central box, an ' LCL ' at that. So out he dumps it into a system car right here an' now, and saves his road about one dollar and fifty cents *per diem*. Of course they pay about one hundred and thirty-five dollars for damages to that brick in the transferrin'. But the boy 's all right in the transfer-house. If he was out on the engine he might blow up the biler."

Here is another great railroad yard — this almost filling a mighty crevice between God's eternal hills. This is within the mountain country, and the gossip that you get around the roundhouse is all of grades. You hear how Smith and the 2,999 pulled seven Pullmans around the Saddleback without a pusher; how some of the big preference freights take four engines to mount the summit; the tales of daring are tales of pushers and of trains breaking apart on the fearful mountain stretches.

Randall is yardmaster here, and Randall is the opposite of the layman's picture of a yardmaster — a slovenly, worn, profane sort of fellow. Randall does not swear; he rarely even gets excited; his system of administration is so perfectly devised that even in a stress he rarely *has to turn* to work with his own hands. With him rail-

SOMETHING OVER A MILLION DOLLARS' WORTH OF PASSENGER CARS ARE CONSTANTLY STORED IN THIS YARD

A SCENE IN THE GREAT FREIGHT-YARDS THAT SURROUND CHICAGO

roading is a fine, practical science. He will tell you of the methods at Collinwood, at Altoona, at Buffalo, at Chicago — wherein they differ. He is cool, calculating, clever, a capital railroader in addition to all these.

You speak of his yard as being overwhelmingly big. He answers in his deliberate way:

"We 've more than 200 miles of track in this yard; something more than 2,000 switches operate it."

Then he takes you down from his office, elevated in an abandoned switch-tower, and looking down upon his domain. He explains with great care that, his yard being a main-line division point and not a point with many intersecting branches or "foreign roads," its transfer-house is inconsequential. The same process that goes forward with the package-freight in the transfer-houses, Randall carries on in this yard with cars. These operations are separated for east-bound and west-bound freight and each is given an entirely separate yard, easily reached from the group of roundhouses that hold the freight motive power of that part of the system. Randall's, being an unusually large yard, further divides these activities into separate yards for loaded and empty cars on the west-bound side. No east-bound "empties" are handled over his road.

We follow him to the nearest operating point, the west-bound classification yard for loaded cars. In the old days this was a broad flat reach of about 20 parallel tracks, terminating at each end in approaches of lead of "ladder" track. Upon each set of 3 or 4 tracks a switch-engine is busy in the eternal classification process. In these more modern days you may see the "hump" or gravity-yard, although you will still find skilled railroaders who are prejudiced against its use. In the hump-yard half of the work of the switch-engines is done by gravity. This new type of railroad facility has an artificial hill, just above the termination of the parallel tracks where they cluster together, and upon this hump one

switch-engine with a trained crew does the work of six engines and crews in the old type of yard.

A preference freight rolls into the receiving yard for the west-bound classification. Its engine uncouples and steams off for a well-earned rest in the smoky roundhouse. A switch-engine uncouples the caboose that has been tacked on behind over the division, and it is shunted off to the near-by caboose track, where its crew will have close oversight of it — perhaps sleep in it — until it is ready to accompany some east-bound freight a few hours hence.

Blue flags (blue lights at night) are fastened at each end of the dismantled cars, and the inspectors have a quarter of an hour to make sure if the equipment is in good order. If the car is found with broken running-gear it is marked, and soon after drilled out from its fellows, sent to the transfer-house to have its contents removed, to the shops for repairs, or the " cripple " track for junk, if its case is well-nigh hopeless.

With the " O. K." of the car inspectors finally pronounced, the train that was comes up to the hump, and the expert crew that operates there makes short work of sorting out the cars — this track for " stuff " southwest of Pittsburgh, this next for Cleveland and Chicago, the third for transcontinental; and so it goes. Two lines of cars are drilled at the same time, for just ahead of the switch-engine is an open-platform car, known as the " pole-car," and by means of heavy timbers the " pole-man " guides two rows of heavy cars down the slight grades to their resting-places.

The cars do not rest long upon the classification-yard tracks. From the far end of each of these they are being gathered in solid trains, one for Pittsburgh, another for Cleveland and Chicago, the third transcontinental, and so on. Engines of the next division are being hitched to them, pet " hacks " brought from the caboose tracks, and the long strings of loaded box-cars are off toward the West in incredibly short time.

Of course there are some trains that never go upon the "classification" at Randall's yard. There are solid coal trains bound in and out of New York, of Philadelphia, and of Boston, that pass him empty and filled, and only change engines and cabooses at his command. There are through freights, bound from one seaboard to the other, from the Far East to the Far West, that do likewise. But the majority of the freight movement has the sorting out within his domain, his four humps are busy day and night with an ordinary run of traffic, and you shudder to think what must be the condition when business begins to run at high tide.

"We get it a-humming every once in a while," he finally confesses. "We had one day, a little time ago, when we received 121 east-bound trains in twenty-four hours, more than 3,200 cars all told. That meant, on an average, a train every 11½ minutes. That same day we got 78 west-bound freights, with more than 3,600 cars. That meant nearly 7,000 cars handled on the in-freight in twenty-four hours, or a train coming in to me every 7½ minutes during day and night. They don't do much better than that on some of the subway and elevated railroads in the big cities; and I have n't said a word about the trains and cars we despatched — just about as much again, of course."

Through yards such as these there are incoming streams of merchandise, equal at least to the outgoing, passing through classification yards in carload lots and the great transfer-houses in "LCL." These streams must be kept separate and from clogging one another or themselves. Cars must carry loads whenever they are moved — "empties" are the bogy-men of the superintendents of transportation — and cars from "foreign" systems must be quickly returned to their home roads. The yardmaster at a busy freight point has his own worries. His puzzle is unending. To it he must bend the bigness of a big mind, he must be prepared to handle the unequal

volumes of traffic that pass through his domain with an equal skill: in dull times he must seek to keep his plant working under conditions of rare economy; when the freight rises to flood tide, he must fight in harness to prevent the freight from congesting. The word "failure" has been stricken out of his vocabulary by his superiors.

It takes a high grade of railroader to serve as yardmaster.

CHAPTER VIII

THE LOCOMOTIVES AND THE CARS

HONOR REQUIRED IN THE BUILDING OF A LOCOMOTIVE — SOME OF THE EARLY LOCOMOTIVES — SOME NOTABLE LOCOMOTIVE-BUILDERS — INCREASE OF THE SIZE OF ENGINES — STEPHENSON'S AIR-BRAKE — THE WORKSHOPS — THE VARIOUS PARTS OF THE ENGINE — CARS OF THE OLD-TIME — IMPROVEMENTS BY WINANS AND OTHERS — STEEL CARS FOR FREIGHT.

FROM out of the fiery womb of steel comes the locomotive. We have already told of the honor that is forged in the building of the bridge; honor of no less degree has gone into the forging of the most vital and most human thing upon the railroad, outside of man himself. That man has ever been able to create and build the locomotive, a giant creature of some 200 tons, perhaps, built together with infinite care of some 5,000 to 7,000 parts, and these parts acting with the delicacy of the hair-spring of a watch, almost passes ordinary belief. The wonder becomes even greater when it is realized that this monster creature, set upon two slender rails, is capable of pulling a 4,000 ton train, through every stress of weather and over considerable grades.

To tell in detail of the locomotive in one chapter is short allowance to a subject that fairly demands for itself a whole book, a technical mind for the telling, and at least a fairly technical mind for the understanding; a subject that in its history goes hand in hand with that of the railroad itself. Yet the limitations of this book forbid a more lengthy description.

We have already told of a very few of the earliest and most famous American locomotives; the *Stourbridge Lion*, which Horatio Allen *brought to* the Delaware & Hudson

Company; the *Best Friend,* which was built in New York City, and which went to Charleston, South Carolina, to be the first American locomotive to run in the United States, the *De Witt Clinton,* which awoke the echoes of the Hudson and Mohawk valleys in a single day; and the *Tom Thumb,* built by Peter Cooper, which induced the directors of the Baltimore & Ohio Railroad to change their motive power from horses to steam, and so opened a great new development for their property.

A little while after Cooper's *Tom Thumb* had achieved the astounding feat of beating a team of horses in hauling a railroad coach, the directors of the B. & O. offered a prize of $4,000 " for the most approved engine that shall be delivered for trial upon the road on or before June 1, 1831; and $3,500 for the engine which shall be adjudged the next best." It was determined in this prospectus that " the engine, when in operation must not exceed three and one-half tons weight and must, on a level road, be capable of drawing day by day fifteen tons, inclusive of the weight of wagons, fifteen miles an hour."

Three locomotives answered this generous offer. Of them but one, the *York,* oftener called the *Arabian,* built at York, Pa., by Davis & Gartner, and hauled to Baltimore by horses over the turnpikes, was of practical service. Phineas Davis was a watch and clock maker, but he succeeded in devising a locomotive that was the forerunner of the famous *Grasshopper* upon the Baltimore & Ohio. Better name was never given to a locomotive, the rude and ungainly angles formed by rods and levers giving a distinct resemblance to the long-legged bugs. Yet the Grasshoppers served their purpose. In the late eighties, the *Arabian* was still in service in the Mount Clare yards at Baltimore. With a single exception, it never had an accident or even left the rails. That exception was just before the completion of the Washington branch, and Davis was a passenger upon the engine. It was going at a fair rate of speed when suddenly it rolled

over upon its side in the ditch. No one was hurt, save Davis, who was instantly killed. It seemed a strange caprice of Fate, for although careful examination was immediately made, both of the engine and of the track, no reason could ever be assigned for the accident.

In that same year, 1831, the *John Bull,* which was built by George & Robert Stephenson & Company, of Newcastle-on-Tyne, in England, was received in Philadelphia for the Camden & Amboy Railroad. As long as the locomotive continues to serve the railroad the name of George Stephenson, its inventor, must be indissolubly linked with it. The *John Bull* was easily the most famous Stephenson engine ever sent to the United States. It has been shown at all our great expositions, and now occupies a position of honor in the great Smithsonian institution at Washington. Of these early engines, which it was found necessary to bring from England, a volume once issued by the Rogers Locomotive Works, of Paterson, N. J., has said:

"These locomotives . . . furnished the types and patterns from which those which were afterwards built here were fashioned. But American designs soon began to depart from their British prototypes, and a process of adaption to the existing conditions of the railroads in this country followed, which afterwards differentiated the American locomotives more and more from those built in Great Britain. A marked feature of difference between American and English locomotives has been the use of a forward truck under the former."

As a matter of fact, the English engines, built for use on long straight stretches of line would never have served on the early roads in this country with their steep and curving routes through the mountains. So, in the latter part of the year 1831, John B. Jervis invented what he called "a new plan of frame, with a bearing-carriage for a locomotive engine" for the use of the Mohawk & Hudson Railroad, in which he introduced the forward truck

would be badly penned in, in case of accident. The Erie contributed the bell-rope signal from the train; we have already heard of that first whistle on the locomotive of the Sandusky and Mad River Railroad. The Boston & Worcester devised the headlight, so that time might be saved by handling freight at night. More important than these were the experiments by Ross Winans and by S. M. Felton that led to the substitution of coal for wood as a fuel, and the development by Rogers at his Paterson works of the link device, so necessary in stopping, starting, and reversing the locomotive.

Gradually the size of the locomotive increased to 28 and 30 tons in the late fifties. Finally James Milholland, engineer of machinery for the Philadelphia & Reading Railroad, built in 1863 a pusher engine for coal trains that weighed something over 50 tons. When folk saw that engine they almost gasped, and wondered what the railroads were coming to. But the wiser men kept silent. They knew that as long as bridges and roadbeds and fine steel rails were increased in strength, the limit of size of the locomotive had not been reached. The greater grip the locomotive has upon the rail, the greater its pulling power, the greater its efficiency. Sheer weight, and weight alone, gives that grip. It certainly takes a weight of seven tons to give a grip of one ton upon a dry rail; in the case of wet rails this ratio becomes ten to one.

Then wonder not that the locomotive steadily increased in size, that the Moguls with six driving-wheels, and the Consolidations with eight, came into vogue a few years after the close of the war, and that these kept increasing in weight all the while. Height and width were and still are rigidly limited by the clearance of the line. The locomotive must stand no more than fourteen or sixteen feet high and from nine to eleven feet wide; in length the problem only meets the genius of the designer.

But it is altogether possible that the limit of the size

enough to lay the foundation of one of the greatest of American single industries, to give his name to a firm that has carried the fame of American locomotives around the world and kept it alive in every nation of the earth. Baldwin's first locomotive was built in 1832 for the Philadelphia, Germantown, and Norristown Railroad; and that it was a good locomotive is proved by the fact that it performed twenty years of faithful service upon that line. His second engine, built two years later, went south to that famous old Charleston & Hamburg Company. After that his works were regularly established, their head to give his patience and untiring genius to the perfecting of the locomotive. The history of Baldwin locomotives is, in an important sense, the history of the industry in the United States.

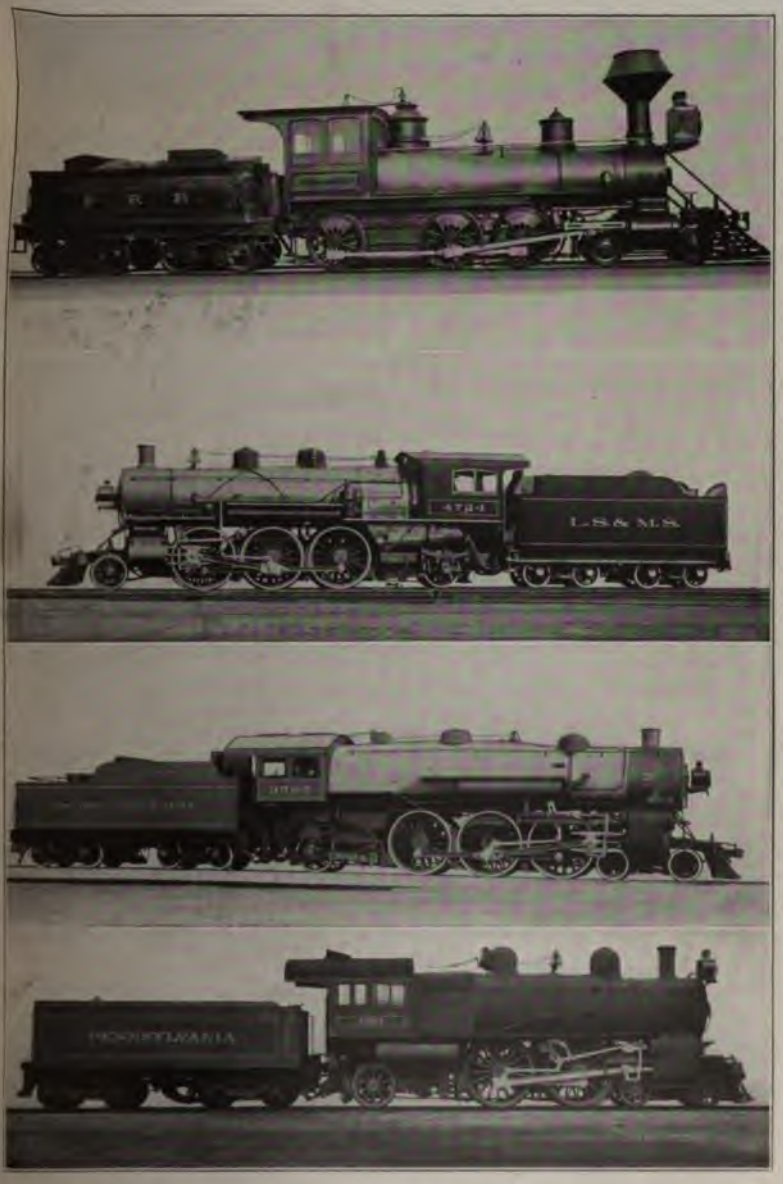
It was not long before the pioneer engines were considered too small for much practical value, and Mr. Baldwin was building a much bigger locomotive for the Vermont Central Railroad. This engine, named the *Governor Paine* for a famous executive of that State, was delivered in 1848, and for it was paid the unprecedented price of $10,000. It had a pair of driving-wheels, six and one-half feet in diameter placed just back of the fire-box, a slightly smaller pair being placed forward. Baldwin must have given full value, for it is related that the engine could be started from a state of rest and run a mile in forty-three seconds. The Pennsylvania Railroad ordered three of the same sort, and one of these once hauled a special train carrying President Zachary Taylor at sixty miles an hour. In weight, the locomotive was steadily increasing. In the beginning, these engines weighed from four to seven tons each; by the late forties engines of twenty-five tons each were being built for the Reading Road, and these were regarded as monsters.

Year by year the locomotive was being perfected in all its details. The cab made its appearance and was first opposed by the engineers, who imagined that they

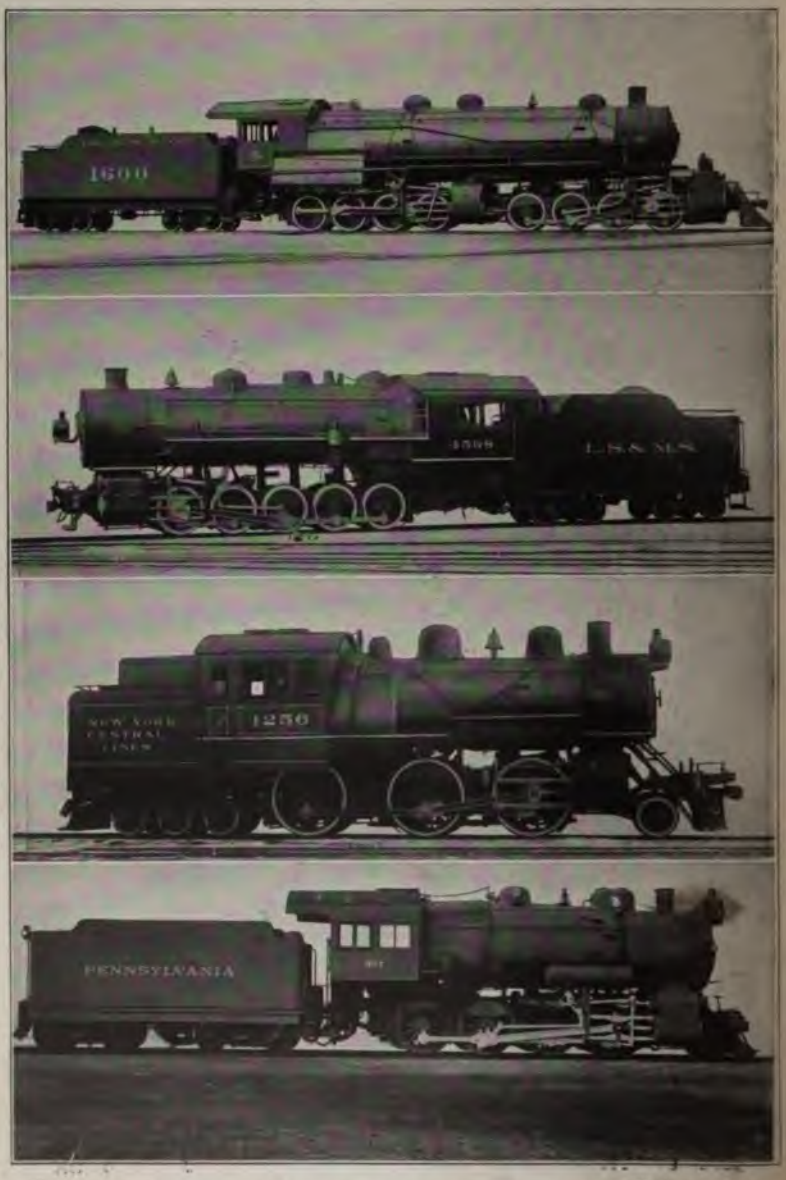
called a "period of adolescence in railroad progress," and in that period they experimented with huge driving-wheels only to discard them once again. Then they built bigger engines than even the *Mastodon;* the *Decapod,* with twelve driving-wheels; the *El Gobernador* which was built by the Southern Pacific at its Sacramento shops in 1884, weighing, with engine and tender fully equipped, 113 tons.

Still the locomotive grows and its progenitors talk of the 500-ton machine. They have recently built the Mallet articulated compound, which because of its very great weight has splendid gripping force and is especially adapted for pushing-service on heavy grades. The Baltimore & Ohio, the Erie, the New York Central, the Great Northern, and the Santa Fe have already become committed to this type of engine. The American locomotive Company has just completed for the Delaware & Hudson several Mallet articulated compounds that are among the most powerful locomotives yet constructed. They were designed for pusher service, on heavy grades, north from Carbondale on the main line of the D. & H., which average from .81 to 1.36 per cent. Up to recently the heavy northbound coal traffic up these grades has been handled by the use of two heavy pusher engines. A single one of the new Mallets will do the work of the two pushers, and therein lies the economy in their use.

These new giants are, in operation, two 8-wheel engines, with individual cylinders, steam chests and supplies from a single boiler and fire-box. The gripping power of 16 driving-wheels under the enormous weight of 223 tons can be imagined; the designers estimate it at the high figure of forty-three tons. The exceptional length of these monster engines — a fraction over ninety feet — is carried around the curves of mountainous lines by an ingenious joint in their solid steel frames. This then is only the latest of American engines; but not quite the biggest, for the Topeka shops of the Santa Fe Railroad



ONE OF THE "DIAMOND-STACK" LOCOMOTIVES USED ON THE PENNSYLVANIA RAILROAD IN THE EARLY SEVENTIES
PRAIRIE TYPE PASSENGER LOCOMOTIVE OF THE LAKE SHORE
PACIFIC TYPE PASSENGER LOCOMOTIVE OF THE NEW YORK CENTRAL
ATLANTIC TYPE PASSENGER LOCOMOTIVE, BUILT BY THE PENNSYLVANIA RAILROAD AT ITS ALTOONA SHOPS



ONE OF THE GREAT MALLET PUSHING ENGINES OF THE DELAWARE & HUDSON COMPANY

A TEN-WHEELED SWITCHING LOCOMOTIVE OF THE LAKE SHORE SUBURBAN PASSENGER LOCOMOTIVE OF THE NEW YORK CENTRAL

CONSOLIDATION FREIGHT LOCOMOTIVE OF THE PENNSYLVANIA

claim that honor with their new Mallets, each 121 feet long and weighing complete 810,000 pounds. The 500-ton locomotive does not seem so very far away when one comes to consider the Santa Fe giants. These engines, which are operated in pushing freights over the heavy grades in the Southwest, were built from two of the Santa Fe's heaviest freight engines. They operate with equal facility in either direction as there is not a turntable in the land which would come anywhere near accommodating them.

In recent years, the rather graceful custom of giving names to the classification of locomotives has been extended to the passenger motive-power. In 1895, the Baldwins created the Atlantic type of four-driver locomotive for high-speed service both on the Atlantic Coast Line and on the Atlantic City Railroad, from Camden to the ocean —and the name has stuck. The Brooks plant of the American Locomotive Company at Dunkirk similarly developed the Pacific type for passenger locomotives with six drivers instead of four. The Prairie type was appropriately enough sponsored by the Burlington system. It is like the Pacific type save that the forward or lead truck (the Englishman would blandly call it the "bogey") has but two instead of the conventional four wheels.

Your locomotive-builder is apt to be more systematic about these types of engine, and he falls back on what is generally known as Whyte's classification. The basis of this simple system is in the number of wheels of the engine itself. Each type is described by a series of three numbers, the first of these being the number of wheels in front of the drivers, the second the number of drivers, and the third the number of wheels to the rear of these. The eight-wheel American type, the simplest for illustration here, would thus be described as "4-4-0."

The trailer, which is described by the third number in this series, is a recent addition to the locomotive family

in this country. It came from the constant lengthenin the fire-box, due to the necessity of providing gre steam-power for engines of increasing weight and cylir capacity. When the fire-box began to overhang too the trailer-wheels were introduced, and a device was affi to the locomotive by which they might receive its wei for hill-climbing purposes. This last device has not pro particularly successful. But the trailer itself has bec a fixed device in locomotive construction. When the tl figure in Whyte's classification is a cypher it simply me that there are no trailers. Similarly the first figur cypher, indicates the absence of a forward truck or e wheels, which is common in some forms of switch-engi where the weight is entirely concentrated on the driv for better gripping power upon the rail.

Such, in brief, is the development of the locomotive. has been development rather than change, for while so designers have fretted about whether the engine's should be in the middle of the boiler or at its end a others have recently developed the Walsheart gears up the outside of the engine frame, where it is of easier acc than the old-style links, the general design of the iron-ho remains practically the same as that given it by our gra daddies. They planned carefully and they planned the long years. The essential features of their desig have not been questioned. It has simply been a probl of growth.

From out of the fiery womb of steel comes the locon tive. If you would better understand the iron horse, fi your way to any of the great plants in which he is bei built. Begin at the beginning in a factory, which seer with dozens of shops and great yards, to be almost a m iature city. Begin at the draughting-rooms where each motive is given a whole ledger page — sometimes t iree — for specifications. From those specificatio young draughtsmen take their instructions. Th

work out their charts and elevations, their detailed plans; and the ink is hardly dry upon their drawings before they are being whisked away to the blueprint rooms. The blueprints are still damp, when in turn they are hurried to the different construction shops of the plant.

You see these shops, one by one, in care of an expert guide. You see the wooden patterns going to the blast furnaces at the foundries and to the sullen tappings of the trip-hammers. You leave the blacksmiths and stand for a moment — not long — under the terrific din of the boiler-makers. The boiler, the great trunk of the locomotive, is built of steel plate — plate that is the very pride of the rolling-mills. In some foreign lands, copper fire-boxes are demanded; but the real American locomotive has these also of steel.

The steel plates are rolled to form the boiler itself, flanged by angle-workers into the square fire-box. Finally the boiler and the fire-box are riveted together, section by section — made as fast by steel thread as man's ingenuity can make them. Together they form a unit. Another unit is being formed in an adjacent shop, the solidly welded steel frame in which the boiler shall yet set, and to which truck and drivers will be firmly fastened. Forward on this frame will sit the cylinders; in another corner of this shop they are being made ready. Cast-iron still remains the best material for the cylinders and the steam-chests. These are cast in one piece and the rule holds good where there are two cylinders, as in the case of the compounds. The cylinders, and steam-chest for one side and half the "saddle" of the locomotive, upon which the forward end of the boiler rests, are nowadays generally made in a single casting. After that it is a simple enough matter to smooth down the outer surface, bore the cylinders to perfect surfacing, and line the steam-chests with a bushing that can be readily removed once it is worn out.

The driving-wheels are an important detail of the con-

struction of the locomotive. They are made in rough castings — of steel for fast passenger engines, and of iron for other forms of motive power — and are then made true in giant lathes. The steel tires are shrunk on the wheels, a work of astounding nicety; and in turn the wheels themselves are heated and shrunk upon the axles — of the best steel that man can forge. To place these wheels upon the axles is hair-line work. A 9-inch hub receives an axle just 8.973 inches — no more, no less — in diameter. It is keyed and then under the slight expansion of a gentle heat it is rammed upon the axle-end. It goes on to stay, and stay it must.

From all these shops, a busy industrial railroad brings the different parts to the great and busy hall of the erecting-shop, a vast place of vast distances and filled always with the noisy clatter of great industry. Here the different parts, which have been carefully built by skilled artisans, are assembled into the finished whole. The cylinders and saddle-halves are placed and firmly riveted together. Into the collar of that saddle a giant overhead crane carefully sets the boiler and the fire-box. They are quickly riveted to the upper flange of the saddle: the locomotive is coming into a semblance of itself.

The cab is fastened into position; then the boiler-makers descend upon the unfinished engine and place the 200 or more flue-tubes that run from fire-box to smoke-box, just underneath the stack. They make every tube and joint fast — put into the growing locomotive all the energy and all the skill of good workmanship. When they are gone the giant crane again comes noiselessly down along the ceiling. It reaches down, grasps the engine-trunk, and swings it high aloft.

Down there, resting on real railroad tracks, are the driving-wheels and the lead truck, carefully spaced in [illegible]ipation. The crane, lifting the fifty tons of boiler and [illegible] with no apparent effort whatsoever, places its load

squarely upon the wheels that are to carry it. Again the mechanics are busy; the engine is growing into a solid unit. Upon their heels follow testers, men who must look for steam or water leaks. They work under a test of air, carrying lighted candles into every nook and cranny of the giant. If the candle flutters, air is escaping, and the leak must be found.

Finally comes the report "O. K." from the testing crew. The stacks, the steam and sand domes, and the air-brakes are being made fast. The engine is hurried off to the paint-shop. There it may find its companion in life, the humble useful tender already awaiting it. It came direct from the tender shop; for the appendage of the locomotive is no longer a specially rigged flat-car but a solid steel plate construction built to carry some 9,000 gallons of water and about 16 tons of coal. Only a little time ago, a New Yorker, scion of a wealthy and famous family of railroaders, proved himself worth his oats by designing a tender of great practicability and of great economy of construction.

When the engine emerges from the paint-shop it is gorgeous and refulgent — brilliantly new. Unless it is going to foreign lands, when it must be partly dismantled and crated, it will ride its own wheels to the road which has purchased it. A string of new locomotives may be sprinkled through a freight train — never coupled together — in charge of an inspector from the locomotive company, who will bunk in one of the cabs and never leave his charges until they have been receipted for. After that the locomotive begins to bend to the work for which he was created. Unless he is of a very unusual sort or was built for some very especial purpose, he soon loses his identity. The days are gone when locomotives were christened after the fashion of ships. There are too many of them. Each is given the cold informality of a number, marshalled for service in a mighty company.

Cars came as corollary to the locomotive. In the beginning the passenger coaches were nothing more or less than old-time stage-coaches which had been set upon wheels so flanged as to enable them to stay upon the rail. So it was that the first cars built for the railroad followed stage-coach models. It was a practical necessity from the first to draw more than one small coach at a time, so the couplings and the bumper devices came as a matter of development. Then came the day when an aspiring inventor grouped several stage-coaches together on a single rigid frame and he had really developed a form of railroad coach — a form which our English and continental cousins still cling fondly to, in despite of its most apparent disadvantages.

Four wheels quickly gave way to eight. In the early thirties, Ross Winans developed a double-truck car for use on the Baltimore & Ohio. Compared with anything that had gone before it was certainly a pretentious vehicle. It was thirty feet in length, four-wheel trucks being attached at the ends, very much after the present fashion. There were seats on the flat roof, which were reached by a ladder in the corner, and the car itself was divided into three compartments. A little later Winans tore out the cross partitions in the car and introduced the end doors and the centre aisle, thus establishing the American passenger coach of to-day. The Baltimore & Ohio manufactured a number of these coaches at its famous Mount Clare shops. They were known for years as the "Washington cars," probably because they were the first run on the Washington branch.

If Winans had been able to establish his patent rights to the double-truck car he might have reaped a fortune from its royalties alone. But when he went to assert his right as an inventor, it was discovered that the idea was not absolutely new. Gridley Bryant, in his old Quincy Granite Railroad, just south of Boston, had used the device in crude form. The four-wheeled flat cars which he had

employed in bringing stone from the quarries down to the dock were not long enough for granite slabs. He had met that emergency by fastening two of them together with coupling-rings, and thus in a way had created the eight-wheel car. So Winans lost his patent although credit is given him for having really developed the passenger car of to-day.

The form, once set, came quickly into vogue. In a few of the Southern States, old-fashioned gentlemen followed the early English fashion of having their private carriages attached to flat freight-cars whenever they went on railroad trips, but even this was a passing fad. At that time carriages were no novelty, and railroad cars were. They were stuffy little affairs compared with the coaches of to-day, miserably lighted and heated and ventilated, but Americans were very proud of them. The fashion that made early locomotives gay with color, with brass and burnished metals of other sorts, found full scope upon the passenger cars, both inside and out. They were pannelled and striped, ornamented and lettered to the limit of the skill of gifted painters. A coach, named the Morris Run, on the old Tioga Railroad, which began running south from Elmira about 1840, was decorated in red and green and yellow and blue and gilt and several other colors. It would have made a modern circus band wagon inconspicuous. But the day came when the brass stars and the red stack-bands began to disappear with the names from the locomotives and in that day the railroad cars became subdued in colorings. Some of the gay frescoes of the interiors, typical of the taste of an earlier day, were in use within the present generation.

While the "Washington cars" set a type, there was much yet to be accomplished in the development both of the passenger coach and of the freight car, and this much was chiefly in the line of the development of safety devices. The old-time passenger rode in a very decent fear of his life. Sometimes a loosened end of one of the "strap rails"

would come plunging up through the flimsy floor of the coach and impale some unfortunate passenger upon its end against the ceiling; other times the cars would go rolling off the banks and crashing into kindling-wood against one another. They were lightly built contrivances, incapable of standing any sort of shock or collision.

But improvements came one by one — better devices for coupling them together, culminating in the modern automatic "jaw coupler," better framing, better platforms, better trucks, improved hand-brakes; and after them the now universal air-brakes made life safer both for the traveller and the railroad employee. Finally came the steel-end vestibule; and where cars have been equipped with this very comfortable device, telescoping in collision, a very common and disastrous accident in which one car-shell enveloped another, has been rendered impossible.

The car-platforms for many years remained a menace and a problem. An early railroad in New Jersey sought to emphasize their danger by painting on an inner panel of each car-door a picture of a newly made grave, surmounted by a tombstone, on which was inscribed: "Sacred to the memory of a man who stood upon a platform." The railroad used every method to keep its passengers off the platforms at first. Afterwards they began to encourage it and to devise means to promote a general intercourse between the cars.

The dining-car, of which much more in another chapter, was a prime factor in this change of attitude on the part of railroad officers. Its use necessitated passengers going the length of the train, a movement which, in itself, was facilitated by the main design of American cars, as differentiated from those of English railroads. When the English roads began the universal use of dining-cars they had to revamp the entire plan of their car construction and produce what are still known across the Atlantic as "corridor trains."

To make such communication safe, George M. Pullman,

he sleeping-car man, set forth to devise a platform protection. Back in the fifties there had been something of the sort on the old Naugatuck Railroad in Connecticut, rough canvas curtains enclosing the platforms; but these had been built to facilitate car ventilation, and failing in this, they were abandoned after three or four years of trial. Pullman did better. He devised a platform enclosure of folding doors and placed a steel frame at the end of his vestibule that did more than merely protect passengers from the stress of weather; these, of course, then served as effective anti-telescoping devices. The Pennsylvania Railroad began the use of these vestibules in 1886 and they were soon universally adopted by American railroads on their fast through trains.

After that a better vestibule was devised by Col. W. D. Mann, one that extended the full width of the car. In fact the platform of the car had practically ceased to exist, the structure being full-framed to include its entrances at both ends.

After the vestibule came the steel car, introduced within the past ten years for freight service, and within the past five or six for passenger equipment. It has everything to commend it, save a slightly increased original cost, which is more than compensated by economy of maintenance, to say nothing of the intangible but certain raised factor of safety. It is to become universal; the wooden car will become extinct upon American railroads almost as soon as the present equipment is worn out and sent to the scrap-heap.

Of the forms and varieties of railroad passenger coaches there are many, and these will be described when we come to consider in a later chapter the luxury of modern railroad travel. But the variety of passenger equipment quite pales before that of the freight service. Flat-cars, coal-cars, box-cars, grain-cars, live-stock cars — the list runs on into catalogue form. There are refrigerator cars that are kept filled with salt and ice or ice alone, precooled cars

that are merely kept air-tight, and ventilator cars employing a distinct reverse of that method; and up in northern climates there are heater-cars which are kept warm by lamps or by stoves and which are used for the transportation of fresh fruit and vegetables in winter just as the refrigerator-cars and the precooled cars are used for that same purpose in summer.

Almost all the safety devices that have been added to the running-gear of the passenger equipment have been added to the freight equipment also, to the great safety and peace of mind of the railroad employee. The car itself remains the simple essential of the very beginnings of the railroad. Its change has been a change in size, in weight, and in strength.

The first freight cars of the very old railroad at Mauch Chunk weighed 1,600 pounds each, and were permitted to carry a weight or "burden" of only 3,200 pounds. When the Boston & Albany first began using freight cars 30 feet long, it was so confused that it gave each end of the car a separate number for convenience in billing and designating consignments. Nowadays 40 tons is the right load for an efficient car, although they go as high as 55 and 60 tons' capacity; the car itself may weigh approximately half that figure.

Freight cars by hundreds of thousands go bumping all over the different railroads of the land, and all the while they are getting bumped and broken in accidents — large and small. In such cases they are hauled to the nearest shop of the railroad upon which they are travelling and there repaired at the cost of the road that owns them. In earlier days, the job of master mechanic was no sinecure, for each road built its cars upon its own plans and no two of these plans were alike. A simple broken part necessitated the manufacture of a new part. It was a matter of great confusion and expensive to every line.

The organization of the Master Car Builders, in 1867, *solved that* problem. This organization, through com-

mittee, made first the freight car standard and then the passenger standard. Axles, bolts, king-pins — every one of the intricate car-parts — were brought to standard and numbered sizes. After that all that a master mechanic had to do was to keep an assortment of standard car parts in his store-room, and he could make reasonable repairs to any car that travelled rails. The standardization has gone steadily forward year by year; it has included a variety of things, even such details as systematic numbering and lettering of cars. It is one of the evidences of the constant bettering of the American railroad, the steady effort to bring it to an economical and scientific basis.

Recently some of the railroads have made intelligent experiments, seeking to devise a vehicle that should be both locomotive and car, and that should be especially adapted for small side-lines, where traffic runs exceedingly light. Some success has been found in the use of a passenger coach, into which a gasolene engine has been introduced, and several of these cars are in regular use in the West. Two or three of them have been employed for three or four years on Union Pacific branches in and around Denver. They render a possible solution for one railroad problem — the problem of providing sufficient service for some branch where local traffic is slight. The gasolene car requires but two men, as against a minimum crew of five men for even the smallest steam passenger train. It can be quickly handled, will make many successive stops readily, and generally provides an efficient addition to the regular passenger equipment. A few years ago it would have given the standard steam railroads an excellent weapon against the constant encroachments of paralleling electric roads through their good passenger traffic districts; even to-day it offers a possible solution of the difficult problem of the very small branch side-lines.

CHAPTER IX

REBUILDING A RAILROAD

RECONSTRUCTION NECESSARY IN MANY CASES — OLD GRADES TOO HEAVY — CURVES STRAIGHTENED — TUNNELS AVOIDED — THESE IMPROVEMENTS REQUIRED ESPECIALLY BY FREIGHT LINES.

TO the operating heads of the great railroad systems, rebuilding a line is to-day a far more important problem than the building of new routes. The country has grown — grown in wealth, among other things. The causes that demanded the very greatest economy in the building of early railroad lines no longer exist. The hill that the early engineer carefully rounded with his line is now pierced without a second thought. Grades that were once deemed slight are now classed as impossible. The almost infinite development in the operation of the railroad has seen the grade or the curve, not as a slight matter, but as a matter which, however slight in a single instance, becomes in the course of constant operation a heavy operating expense. To-day the operating folk of the big railroads are counting the pennies where they countlessly multiply in these fashions; it is one of the greatest factors in the grinding operation competition between the great railroad systems of the country.

It is all quite as it should be. The early builders did the best that they might do with the opportunities that were theirs. They got the railroad through. It developed wealth for itself, as well as for the territory it served; and with that wealth it is enabled in these piping days of peace and plenty to correct the alignment errors of the early builders. Moreover, there are frequent cases where the steady increase of traffic has rendered it neces-

sary for a railroad to parallel its trunks with new lines, quite aside from the consideration of grade and curve.

As far back as the early fifties this great work of rebuilding the trunk-line railroads was begun. Certain serious errors in the original alignment of the Baltimore & Ohio Railroad between Baltimore and the Potomac River were corrected, even though at a considerable expense. As time went on, other railroads continued this correction work. It is still being prosecuted east and west of the Mississippi. Ten million dollars, fifty million dollars, looks like a lot of money to the stockholders of any company, when their president tells them that this is to be the cost of this new relief line, this reconstruction, that cut-off; but what is $1,000,000 when it is going to save more than $100,000 a year in the operation of your railroad? It is the big sight of the big situation that the railroads make nowadays at this reconstruction work.

Mr. Harriman, with his transcontinentals from the Mississippi watersheds west, was almost the pioneer in this work of wholesale reconstructon. The wholesale operating benefits that have resulted from it in the case of his group of Pacifics have been largely responsible for his preeminence in the railroad world. And yet, once his method was tried, it all seemed simpler than A, B, C.

Take the case of the Lucin cut-off on his Southern Pacific. When the Union Pacific was being pushed across the plains and threaded over the Rockies and the Sierras, the Great Salt Lake of Utah lay directly in its path. The railroad did the obvious thing and carefully made a detour around the lake. When Mr. Harriman took over the Union Pacific, then in a state of physical decadence, and linked it with his Southern Pacific, and surveyed the situation carefully, he decreed that the Great Salt Lake should no longer cause a trunk-line railroad to double in its path. He caused a line to be surveyed direct across the marshy lake from Ogden to Lucin and when that was done he had a line — on paper — 103

miles long as against 147 miles by the old line. The engineer hesitated, but Harriman urged and they courageously began the construction of miles and miles of embankment and of trestle. Then new difficulties arose. Sink-holes developed. In a few minutes structures that had been the work of long months silently disappeared. The engineers in charge came to Harriman.

"It is not possible," they told him.

"You must carry it through whether it is possible or not," Harriman replied.

Eventually they carried it through.

When it was done, the Union Pacific had not only shortened its transcontinental line 44 miles, but it had eliminated more than 1,500 feet of heavy grade and 3,919 degrees of curvature. An operating economy of between $900,000 and $1,000,000 a year had been effected and the stockholders of the company had a good investment for the $10,000,000 that the Lucin cut-off had cost them.

Nor was that all on the Union Pacific. On other sections of its main line similar reconstruction work had added to the economy of operation by millions of dollars each year. For twenty miles west from Omaha, where the old historic transcontinental formerly dipped south to avoid a series of undulating hills, the new Lane cut off cuts squarely across them — 20 miles of deep cuts and heavy fills — "heavy railroad," as the engineers like to put it. And again, where the old line twisted and wound itself over the Black Hills, and wobbled unsteadily through Wyoming, the reconstruction engineers pressed their work.

It is not generally understood that the summit of the Union Pacific is in the Black Hills, which are the first foothill range of the Rockies, rather than in the mountain crest beyond. The Black Hills have always been a baffling proposition, with their short, steep slopes. The engineers wrinkled their brows at the thought of correcting

WHERE HARRIMAN STRETCHED THE SOUTHERN PACIFIC IN A STRAIGHT LINE ACROSS THE GREAT SALT LAKE

LINE REVISION ON THE NEW YORK CENTRAL — TUNNELLING THROUGH THE BASES OF THESE JUTTING PEAKS ALONG THE HUDSON RIVER DOES AWAY WITH SHARP AND DANGEROUS CURVES

the old line through there, but Harriman simply said that they must, that the board — which meant E. H. Harriman himself — had directed that 247 feet be cut from the road's crest there; and 247 feet, almost to the inch, was cut. It took giant fills and embankments and an army of men but the grades were brought to a minimum for a Rocky Mountain stretch. Wooden trestles, old and affording a constant fire-risk, were swallowed up in embankments; a single slice through a hill-top, a quarter of a mile long and eighty feet deep, did its part in reducing the grades; antiquated cars disappeared before equipment of the modern class; dilapidated shanties were supplanted by fine, permanent railroad stations. The new Union Pacific is a monument to the reconstruction engineer — and to E. H. Harriman.

The Canadian Pacific Railway, while traversing but one small northeastern corner of the United States, is essentially an American railroad, both in equipment and in operation. It forms an important half of that all-British Red Line encircling the globe, of which any Englishman is so very proud. When the Canadian Pacific Railway was completing its last link in this unbroken line of rails from St. John, N. B., and Montreal, to Vancouver, the question of grades was indeed a secondary one. The vital thing was to cut the line through, and to that end great sacrifices of grade efficiency were made. So that when the line was through, and the first Imperial Limited was making its way from the Atlantic to the Pacific over a single railroad system, it was indeed a line with structural defects. At one point — the famous Big Hill, near Field, Alta.— in order to overcome the steep Rocky Mountain climbs, it was necessary to use from four to six engines for comparatively light freight and passenger trains. And at that, it was difficult to attain a speed of more than four or five miles an hour.

Within the last three years, this fearful grade has been corrected by the very first spiral tunnels ever built upon

the American continent. Spiral tunnel construction of this kind is not new. It has been used with remarkable success by the railroads of Continental Europe, in piercing the High-Alpine boundaries between France, Germany, Austria, and Italy.

Coming from the east on the Canadian Pacific Railway, the train first enters the spiral tunnel — they call it the "corkscrew" out in Alberta — under Cathedral Mountain. This first bore is some 3,200 feet in length. Emerging from it, the train runs back east across the Kicking Horse River, then enters the eastern spiral tunnel, and after describing an elliptic curve, emerges, and again crosses the Kicking Horse westward. This whole thing is a perfect maze — the railroad doubling back upon itself twice, tunnelling under two mountains, and crossing the river twice in order to cut down the grade. The work cost $1,500,000. The mere cost of the explosives came to over $250,000. It was one of the really great tunnel jobs of the world. Yet despite the complicated work caused by the spiral shape of the tunnels, they met exactly. The worth of the thing to the Canadian Pacific is shown in the fact that those same trains that formerly required four to six engines, are now handled easily over this Big-Hill grade with but two engines, and at a speed of about twenty-five miles an hour.

Other railroads by the dozen, whose lines traverse mountainous or even hilly country, are engaged in this proposition of lowering their grades. F. D. Underwood, president of the Erie, and known as one of the ablest operating heads in this country, has been engaged in cutting off some of the heavy hill-climbs on that old-time route from the seaboard to the lakes. Underwood has already seen Erie's hopes of success in developing the property as essentially a freighter and for the immediate improvement of that portion of its facilities he has built three new relief lines, a small stretch near Chautauqua Lake in western New York, and then through the upper Genesee

Valley, the third and most important eastward from a point near Port Jervis and piercing the summit of the Shawangunk Mountains.

The line through the Genesee Valley extends from Hunts, on the Buffalo division, about 20 miles west of Hornell, to Hinsdale on the main line, and is 33 miles long. It cuts off a heavy grade between Hornell and Hinsdale on the main line — a little over one per cent — for both east-bound and west-bound freight. At that particular point, Erie's west-bound freight approximates 75 per cent of the east-bound, and so the new line recognizes that fact by establishing the west-bound maximum grade at 3-10 of one per cent, as against a maximum of 2-10 of one per-cent in the other direction. Brought to a plain understanding, a single locomotive has no difficulty in handling 80 cars, each bearing 40 tons of coal, over this new low-grade line. To take one-half that load over the old main line required a pusher.

On the east end of the line, where Erie's engineers built their greatest low-grade cut-off, the coal rolls down to the seaboard in such quantities as to make the west-bound tonnage only a quarter of the east-bound; so the reconstruction engineers were satisfied with a maximum west-bound grade at 6-10 of one per cent as against the maximum of 2-10 east-bound, in the direction of the heavy traffic. The cut-off, which is double-tracked and is 42½ miles long, increases the distance from New York to Chicago 8 miles; but this is not an essential fact, for, like the Genesee Valley Road it is built exclusively for freight service, and not only almost triples the hauling capacity of a locomotive but actually permits of faster running time for the freight trains between Jersey City and Port Jervis. To build the cut-off required a really great expenditure, for like all these new lines it was "heavy work," embracing a tunnel nearly a mile long under the crest of the Shawangunk Ridge, and a steel trestle over the Moodna Valley, 3,200 feet in length and 190 feet high. Still

President Underwood can contemplate his locomotives hauling three times their old loads over it. The economy of such a proposition becomes apparent upon the face of it.

The Baltimore & Ohio, the Southern, and the Norfolk & Western have recently lowered their grades and straightened their curves in similar fashion; the Lehigh Valley, by the erection of a great new bridge at Towanda, Pa., has taken a bad link out of its main line; the Chicago & Alton, when the engineers told it that it must abandon miles upon miles of its main line (for long years its pride) and build anew, told those engineers to go ahead. Stretch by stretch the old road was revamped to meet in every way modern conditions. A steel bridge across the Missouri, which was the first steel bridge built in America, and which cost $500,000, was sent to the scrap-heap while the old-timers groaned. "That which yesterday was a railroad marvel becomes a curiosity to-morrow," observes Frank H. Spearman, in speaking of this very thing.

The rebuilding of the Chicago & Alton was a clean-cut affair. The 70-pound rails were torn from the main line and sent to sidings and branch lines in favor of the 80-pound rails; for while men were tearing at the tracks, the shops were working overtime; 55-ton freight engines that could haul 30 cars were to give way to 165-ton motive power, capable of picking up and carrying a hundred cars with ease. That was why the old bridge had to go in favor of one which cost an even million dollars. And when the Alton built heavy new bridges at dozens of other points besides the Missouri, it built them after the new fashion, with solid rock ballast floor, affording additional comfort and safety to its patrons.

In a flat State like Illinois there were no very serious grade defects to be corrected, but through the gentle undulations of rolling country the line twisted and turned like a lazy brook. The rebuilders stopped that. When *they were* done there was a single section of 40 miles,

ıight as the arrow flies, and many tangents of from to 29 miles. In some cases when the trains were transred to the completed line, the old, spindly, wobbly affair ıld be seen for miles in roadbed, to the one side or the ıer of the new. In some cases, this abandoned rightway was sold to interurban electric railroads; in one parıar case one of the abandoned bridges was included in sale.

The Delaware, Lackawanna, & Western is one of the time Eastern Roads that have waxed immensely prosous with the years. Originally built as an anthracite l carrier from the Eastern Pennsylvania Mountains to seaboard, it has developed into a through freight and senger carrier of importance. The old-time engineer :w how to plan good railroads; the Pennsylvania to- is building its new low-grade freight line on the very veys made by its pioneer surveyors three-quarters of a tury ago; but, as we have already intimated, those rail-.ds were financially weak. Early annual reports of the ınsylvania tell how its stock was peddled in Philadelphia ım house to house — up one street and down another and how sometimes two houses joined together to buy ıingle share. Money was not plentiful in the middle the last century.

So the Lackawanna engineers were compelled to build :ir road in semi-mountainous districts, along the lines least resistance, rather than by the most direct routes. ı it came east from Scranton over the Pocono Mounns it found its way in a roundabout course to the middle Northern New Jersey. The road wound south and en wound north again, its grades were steep, some of its rves were short, and it dipped through two tunnels — e at Oxford Furnace, the other at Manunka Chunk.

To iron out those time-taking dips, the sharp curves, the ades, and the tunnel, the Lackawanna cut-off — the heaviest" bit of railroad in the world — was begun

three years ago. A new route 28½ miles long w
veyed diagonally across from Port Morris on the ma
in New Jersey to the main line again at the De
Water Gap. Despite the fact that it must cross the
sheds diagonally — the watersheds formed by deep
and high rocky ridges — the line as surveyed anc
is only three miles longer than an absolute air-lin
shortens the Lackawanna's main stem from New Y
Buffalo — already the shortest route between thes
cities — by 15 miles, and brings that busy lake port
within 400 miles from the seaboard.

To cross those watersheds at a sharp diagonal
"heavy work"; and the engineers, to run their str
cut, low-grade line, found that they would have to
tremendous cuts and fills — these last alone totallin
600,00 cubic yards. The Lackawanna's engineer
give you a faint idea of the stupendous size of thes
bankments. To build them up of stone and ear
the rate of a cartload a minute for each working-d
the year would require 81 years for the job. To d
less than three years has meant the employment of
trains of dump-cars, the purchase of 600-acre farm
single borrow-pits, the energy and administration o
engineers.

There have been cuts through solid rock, 65 b
and culverts to be wrought of concrete, a single em
ment (at the Pequest River) three miles in length
feet high, and 300 feet wide at its base. The tra
who rides over the completed double-track road will
but a faint idea of the human labor and the human e
that have gone to construct it.

The great railroad that traverses the State of Pe
vania is another monument to the engineer. The Pe
vania Railroad was no wobbly affair at any time.
grades and curves, considering the character of the co
through which its trunk rests, are not excessive. I

been a good standard railroad for a good many years past. But in 1902, the Pennsylvania found that its troubles rested in the volume of traffic that was being offered it. Over its middle division from Harrisburg to Pittsburgh it was handling as much tonnage as J. J. Hill's entire Great Northern system. The heavy tonnage business began to clog the road's fast passenger traffic (its especial pride) and the fast freight traffic (the mainstay of its shippers), and appeal was made to the reconstruction engineers.

It was no slight appeal at that. Pittsburgh, handling 400,000 freight cars a month, was clogged, congested with such streams as had never before tried to crowd through that narrow neck of the Pennsylvania's bottle and the orders that went forth for relief were emphatic. Vice-presidents, general managers, superintendents and general superintendents, and engineers of every sort crowded into the president's office in Broad Street Station, and out of that conference the plans for an exclusively low-grade freight line from New York to Pittsburgh and for the traffic relief of Pittsburgh itself were born.

Every large city has become, in a sense, a bottle-neck for the important railroads that pierce it. In some cases like Chicago or St. Louis or Kansas City or Indianapolis, the situation has been solved by the creation of belt-line freight railroads partly or entirely encircling the town. At Buffalo, the New York Central lines have built a connecting line to enable through traffic to escape the congestion of city yards and terminals, while at New Haven, the road of the same name has recently spent several million dollars in enlarging its narrow throat in the middle of the town.

But nowhere else did the situation approach that at Pittsburgh. Through the Pennsylvania's passenger station there poured not only an abnormally heavy passenger traffic, owing to a heavy suburban service, but every pound of freight bound between the parent company and its two great subsidiaries, the Panhandle and the Fort

Wayne. There were further complications right at the station, owing to the proximity of two of the very worst grade-crossings in America, where Penn and Liberty Avenues swept their busy tides of city traffic all day long over the Fort Wayne's main line tracks. It was a problem that called for the best in engineering skill — and received it.

The Pennsylvania dug deep into its pocket-book and solved the problem magnificently. It began by going back to the vicinity of its great Pitcairn freight-yards at the east of the city, and from them building two connecting laterals (the one to the south and across the Monongahela River to connect with the Panhandle tracks, the other to the north — known as the Brilliant cut-off) across the Alleghany and connecting with the tracks of the West Penn Railroad, which in turn connected with those of the Fort Wayne in the one-time city of Allegheny. That sounds simple, but it was in reality a fearfully expensive undertaking. The mile of Brilliant cut-off, " heavy work " every inch of it, cost $5,500,000, and is to-day the most expensive mile of railroad track in the world.

But the gripping hand was off the traffic throat of Pittsburgh and commercial Pittsburgh breathed more easily once again. The Union Station and its approach tracks were restored to passenger uses; and in the course of things the Pennsylvania tore down the old station, built a new one, and wiped out the two wicked city crossings, as with the stroke of an Aladdin's hand.

So much for Pittsburgh. Now consider the great new freight line leading to the east from there. Not all of that railroad has yet been built, but the greater part of it is already completed, and every part of the old road that was under tension because of freight congestion has already been relieved.

To build this new double-track railroad across 350 miles of a mountainous State, the engineers studied two

-grade and curvature. Distance was no object,
:d is the very last attainment of heavy tonnage
nt. The new route consisted in part of the en-
ıt of the old routes, and in part of the construc-
ırand new line. It started east from Pittsburgh,
ıe great Brilliant cut-off had been built to relieve
endous terminal freight congestion, and followed
alley of the Alleghany River on the route of the
nn Road, a Pennsylvania property. The main
he Pennsylvania comes east from Pittsburgh up
y of the Monongahela for a distance, and then
ıuntry to Blairsville Intersection, 50 miles east
ıurgh, where it is intercepted by the low-grade
oute.

Blairsville to Gallitzin, the road winds through
ɔw and forbidding Conemaugh Valley most of

It twists itself through the slender defile of
lle. A dozen years ago or more, when the Penn-
ı engineers were ordered to four-track the orig-
ble-track through that narrow defile in God's
rld, they shook their heads dubiously; then —
fashion of engineers — they went ahead and did
:n the order came for two more tracks in the
row pass, they placed them there, although they
ally to blast out a shelf on the side of the fear-
p mountainsides for the low-grade line.

eyond Gallitzin, where the Pennsylvania pierces
ı great tunnels the very summit of the Alle-
the low-grade line takes its own course once
:aking farther and farther away from the main
for long sections following the trail of the long-
ndoned Portage Railroad. The day is coming
llitzin Tunnels are to be left high in the air.
ısylvania's officers tell you that frankly.

have plans for a six-mile tunnel, to be handled
ic motive-power already made," said one of
t the other *day*, "*and* every year we wait, that

tunnel grows longer, the approaching grades less and less. It will cost money — money into millions of dollars — and it will earn 10 per cent on the investment."

From Gallitzin, the low-grade line delves far south to Hollidaysburgh and then follows the tracks of a former branch line up to Petersburg on the main line, which it parallels to the Susquehanna. Where the main line crosses the Susquehanna at Rockville, the low-grade freight route diverges once again and follows the west bank of the river for a number of miles, completely avoiding in that way Harrisburg and the steel-making towns to the south of it with all of their conditions of congestion. The freight route crosses the broad Susquehanna at Shock's Mills, eight miles north of Columbia, and follows the east bank of the river for twenty miles to Shenks Ferry, where it turns abruptly eastward through the rugged hills of Lancaster County to a connection with the main line at Parkesburg. From thence it follows the main line nearly all the way to Glen Loch, crossing and re-crossing it but at all times retaining its nominal grades. At Glen Loch it makes a wide detour around Philadelphia and its suburbs and reaches with a long straight "short cut" over to the main line at Morrisville near Trenton.

So much for the location of this great line of reconstruction. In grades and in curvatures it has achieved real triumphs. The great tonnage here is also always east-bound — coal and iron coming to the seaboard. Its grades also are chiefly consequential then to the east-bound movement. To that movement the heavy grades are again at the almost incredible figure of 3-10 of one per cent — some seventeen feet to the mile. That will mean more when it is understood that that figure is equal to the pull that is required of an engine to start a heavy freight train upon an absolutely level track. With such a pull, grades become as nothing, and the Pennsylvania's operating department is enabled to run 75 trains an hour

ver this low-grade line; hour after hour upon a 15 minutes' interval.

Ask a Pennsylvania officer what he would do with such traffic on his old main line to-day, and he will tell you that he would rather resign than tackle the proposition. The same thing is true on the New York Central lines. Like the Pennsylvania, that railroad thought a little time ago that with its four tracks it might move all civilization. Its acquisition of the bankrupt West Shore Railroad in the eighties gave it two extra tracks across New York State that for a long time were carried on the company's books as deadwood. Now they are filled with freight operation and bringing in a healthy return to their owners. The growing land is always catching up to its new railroad facilities, no matter how rapidly they may be constructed.

To-morrow?

The railroad operator does not like to think of that. He meets to-day and he plans as best he may against that to-morrow. To meet the great unknown he bids the engineers — those who construct and those who reconstruct — to him, and begs that they exercise their best wits to help him to see a little way into the dim and shadowy future.

CHAPTER X

THE RAILROAD AND ITS PRESIDENT

SUPERVISION OF THE CLASSIFIED ACTIVITIES — ENGINEERING, OPERAT MAINTENANCE OF WAY, ETC.— THE DIVISIONAL SYSTEM AS FOLLO IN THE PENNSYLVANIA ROAD — THE DEPARTMENTAL PLAN AS LOWED IN THE NEW YORK CENTRAL — NEED FOR VICE-PRESIDENT THE BOARD OF DIRECTORS — HARRIMAN A MODEL PRESIDENT — I THE PENNSYLVANIA FORCED ITSELF INTO NEW YORK CITY — ACTIO A PRESIDENT TO SAVE THE LIFE OF A LABORER'S CHILD — "KEEP RI ON OBEYING ORDERS" — SOME RAILROAD PRESIDENTS COMPARE HIGH SALARIES OF PRESIDENTS.

ALL the widely divergent lines of human activity the organization of the railroad converge in t office of its president. He is the focal point of the ent system. More than that, he is its head and front. he is anything less, the sooner he is out of his job t better for both the railroad and himself; for, althou there is a great variety of departments in the organizati of steam railroad transportation and each department w have still greater varieties of activities, there is b a single activity delegated to the office that bears or the modest word " president " in gilt letters upon its doc The function of that office is to supervise. To und stand that supervision better, consider for a moment t rough structure of the railroad.

Its activities are grouped into classes. The activity soliciting business, both freight and passenger, forms t traffic department, in many ways the most important all; for from it comes nearly all the vast revenue neede for the maintenance of the organism. The legal depar ment looks after the railroad's rights — its franchises, i charters, the law fabric of its almost innumerable rel *tions* with the various railroad commissions, legislature

city councils, and town and country boards. If the road be really sizable — with 8,000 or 10,000 or 12,000 miles of track — it will probably organize into separate departments the buying of its great quantities of supplies, the keeping of its intricate books, and the handling of its money. The business of building its lines and structures will need special talent for an engineering department. The department that will employ the great rank and file of the railroad's army of employees is the operating department, called by some big roads the transportation department.

There are two other great factors of conducting a railroad; maintaining its lines — the tracks, bridges, tunnels and other features of the permanent way; and keeping both cars and engines fit for service. This last work, organized as the mechanical department, will probably rank next to operating in the number of its employees, and the value of its equipment is one of the greatest assets of the railroad. It is generally expressed in great shops located here and there and everywhere, at convenient points upon the system.

Generally the maintenance-of-way department comes under operating — it is only fair that a general manager should supervise the condition of the line over which he is expected to operate his trains at high speed and in absolute safety. The same argument should hold true as to the equipment. But right here is the great rock upon which the principle of American railroad organization splits in twain.

From the president's office downward, the system of organization may be divisional or departmental. In the former case, the division superintendent is the real unit of railroad operation: under his guidance and responsibility come not only the operation of the trains but the maintenance both of the line and of the rolling-stock. In the case of departmental organization that superintendent — and also, above him, the general superintendent — ex-

ercises no authority over the engineers of maintenance-o way or the master mechanics of the shops along the systen Those lines of railroad activity do not converge with tha of train operation below the office of the general man ager. The greatest outside power that is given to a di vision superintendent on a purely departmental road is a sort of coöperation with the master mechanic in the mat ter of the men who handle the road's motive power. This coöperation is many times intricate and involved. If the master mechanic and the division superintendent are not harmoniously inclined toward one another, and things very naturally go wrong with the motive-power it is a difficult matter to locate responsibility.

The Pennsylvania system, which is one of the mos perfectly organized in the world, is strongly organizec upon the divisional system. The division superintenden upon the Pennsylvania is indeed a prince above his prin cipality, and he is well trained for his rulership. Penn sylvania men go through the mill. It takes a pretty capable man to combine the ability for handling train and handling men with the intricate knowledge for com mand over an engineering corps devoted to maintenance of-way, as well as command over a machine-shop whicl may employ a thousand skilled workmen. In order t give its division heads that tremendous training, the Penn sylvania sends its men through its own West Point, th great shops at Altoona. The men who have sat in th big, roomy office in Broad Street Station, Philadelphia and who have been addressed as president, have bee proud of the days when they were up in the hills of th Keystone State, standing their trick in overalls at th lathe, or carrying chain and rod over long stretches o track. To-day every Pennsylvania superintendent, pos sibly with a single exception or two, is a civil or mechan ical engineer.

On the other hand, the New York Central has also

THE OLD AND THE NEW ON THE GREAT NORTHERN — THE "WILLIAM CROOKS." THE FIRST ENGINE OF THE HILL SYSTEM, AND ONE OF THE NEWEST MALLETS

THE SOUTHERN PACIFIC FINDS DIRECT ENTRANCE INT
FRANCISCO FOR ONE OF ITS BRANCH LINES BY TUNNELS P
THE HEART OF THE SUBURBS

PORTAL OF THE ABANDONED TUNNEL OF THE ALLEGHANY
RAILROAD NEAR JOHNSTOWN, PA., THE FIRST RAILROAD
IN THE UNITED STATES

been brought into a high state of organization, and stands firmly on the departmental plan.

"We believe that our superintendents should specialize in train operation," says one of the high officers of that road. "In other words, we do not believe that a man, to get his traffic through over a stretch of line, should necessarily know to a fraction of an inch the best wheel-base for an engine of a given type or the precise construction of a truss bridge. Such requirements take away from the special training that is to-day needed for every high-class railroader. A railroader is made better by sticking to one thing and sticking to it faithfully; and our departmental method, by which the maintenance of line and rolling-stock comes under the sole supervision of men expert in those specialties, we think the best. Sometimes we develop a very wizard in traffic handling, who has never had a chance at a technical education."

And there you have the very essence of the other side of the proposition. Between these two sides there are various shadings and gradings, but the question has never been definitely solved. It has reduced the vast complexity in the organization of the modern railroad of the larger size. That has become so very complex it fairly cried for expert relief. One man has recently spent a busy term of years in simplifying the organization of the Harriman lines. To cut the intricate lines of red-tape in a big railroad office, to reduce to a minimum the vast needless correspondence between departments and between branches of a single department, is a problem that calls for genius — and offers for its solution no small reward.

In other days — and we refer to no ancient history, for the electric light was proved and the hundred-ton locomotive already increasing the average tonnage of the American freight train — the presidents of the biggest roads were content to worry along with one or two assistants. But two *decades ago*, the railroads were still

simple matters; there did not exist the intimate relations between one and the others of them, as shown by stock-holdings in competing and feeding lines to-day — the constant waiting of their executives upon the sessions of the different railroad commissions. These complications of American railroading have also further complicated the organizations of the different systems, and have brought a demand for executives of the keenest type. It is no slight strain that a man works under when he becomes the head of a ten-thousand-mile railroad.

So to-day the president of the railroad has fortified himself in the only possible way — by creating vice-presidencies. Each ranking department to-day is apt to be recognized in council by a vice-president; and these heads form a cabinet as informal as that of the Federal Government and, in its way, quite as important. Legal traffic, and engineering traffic each demands a vice-president at that cabinet-board, and gets him. The general manager usually is the vice-president representing operation. One big road has eight vice-presidents. It is indeed a poor property that cannot show three or four men that are the fittest to hold this title.

There is another cabinet where the president must sit, which is formal and recognized; it is the board of directors. Between it and the lesser cabinet the president must take good care that he is not ground as between millstones. The cabinet of his department heads will tell him how he can spend his money; but he must get it from the upper cabinet. It is not always harmonious pulling in the upper cabinet. Imagine for a moment the troubles that sometimes arise in the lower.

You are sitting in the office of a big railroad president, talking straight to that big-shouldered soul himself. Outside is the shadowy roof of the train-shed of a terminal, which is filled with long lines of cars that come and go, of platforms that are black with humans one instant *and quite* deserted the next. The room has the quiet

elegance of a comfortable home library. There are long rows of books upon the shelves; a great table is set squarely in the centre. But it is business — for a ticker is slowly spelling the fate of that railroad and every other railroad, upon the endless tape; a huge map of the system — many thousands of miles of high-class railroad — lies under the glass that covers the table top.

"They don't always pull together," the president of the railroad admits, when you ask him about the lower cabinet. "Sometimes they pull apart when they have honestly different ideas as to policy, and other times — there 's to be a big college football game up at G—— next Saturday. We have only two private cars for our four vice-presidents, every single blessed one of whom wants to go. I don't want to go myself, and I 've contributed my car, but we 're one short then, and the man that 's left is going around like a boy who 's had a chip knocked off his shoulder. He 's just been in here, and I 've settled the matter by hiring a car for his party from the Pullman folks and footing the bill myself. I sent him out ashamed of himself.

"That 's Pete every time. Flares up quick, and every time he flares up I can remember when we were working the day-and-night tricks in a God-forsaken junction out on a prairie stretch of the Great West. He 's like a boy in some ways — awfully fussy about the rights and prerogatives of his department; and he 'll go all to pieces over some little thing if he thinks another man has stepped over on to his side of the line. But let a big situation arise — a flood that sets a whole division of our lines awash; a wicked congestion of traffic in midwinter blizzards; a nasty accident that takes away our nerve — and you ought to see Pete! He 'll be handling the thing as if he were putting a ball up on the links, and he 'll never lose his confident smile. That man in one such emergency is worth the hire of a dozen Pullmans."

You ask about the upper cabinet, and the president

lowers his voice. The board is no matter for light conversation. He steps to the window and points down into the concourse of the train-shed.

"I happen to know that young fellow over there by the mailbox," he answers. "He 's one of our travelling freight-agents. He 's lucky. He works for one boss, and is responsible to him; I work for a whole regiment of bosses, and am held responsible by a group of pretty keen old citizens who gather around this table and put me on the rack.

"There are many interests in this property, and some of them are too big to sleep in the same bed. I have three directors who never speak to one another outside of this room, and rarely ever in it. There is another who represents the holdings of a road that fights this at every turn, and he hurts the property worse than any good husky plague. A big estate, with a bitter aversion to spending money for any purpose whatsoever, has another director here; and a banking interest presents a director who seconds him in every move, fool or good. That is the crowd I have got to work with when I want ten or fifteen millions to hold our own against some other fellow who is crowding us hard for business in our competitive territory or threatening to run a line into one of our own private melon-patches. That boy down there is lucky. He has only got to get out and land a couple of hundred carloads from a shipper who hates corporations worse than politics, and who has just had a claim for spoiled goods turned down by this particular corporation. That boy has the cinch job."

This imaginary railroad president has told you of one of the vital points in the business of the railroad, the necessity for constant teamwork. A railroad head may have the genius of a Napoleon, the stubborn persistence of a Grant, or the marvellous executive ability of a Pierpont Morgan, and be worthless if his board is not work-

ing enthusiastically with and for him. It is not all pie and preserves by any means. The board may set its sweet will straight against his, and he may be forced to execute a policy of which in his own mind he has no trust. It is only once in a generation that a man like Harriman, who can bend a whole mighty directorate to his absolute will, arises. Harriman was a railroad president in the fullest sense of the word.

He rode in his car north from Ogden one day, toward the great National Park of the Yellowstone. At that time the only direct rail entrance to that splendid reserve was by the rival Hill lines. Harriman had called for a report upon the opportunities for the Southern Pacific to strike its own line into the west edge of the Park. That report was being explained to him in great detail as he rode north from Ogden. His chiefs had a hundred practical reasons against building the line. Harriman listened faithfully to the explanation, as was his way. Then he turned to one of the signers of the report, a high officer of his property.

"You have never been in the Yellowstone?" he asked.

The officer admitted that he had not.

"I have," said Harriman triumphantly, "and I am going to build that road."

That road was built and became successful from its beginning; but Harriman was a railroader with the intuitive sense that gives genius to a great statesman or to a great general. The average railroad president does not hold a controlling interest himself and he must be guided pretty carefully by the judgment of his department heads; he must win the coöperation of his board by tact and subtlety rather than by the display of an iron will; and where he leads he must take the responsibility.

The Pennsylvania Railroad, as has already been told in an earlier chapter, recently forced its entrance into New York City and marked its terminal there with a monumental station. That move was a strategy of the

highest order, and was made that the road might place itself upon an even fighting basis for traffic with its chief competitor. But it cost. Two mighty rivers had to be crossed, whole blocks of high-priced real estate secured, a busy city threaded, the opposition of local authorities (who stood with palms outstretched) honestly downed. That all cost. That would have been a mighty expenditure for the Federal Government; for a private corporation it was all but staggering.

When the station was finished, a rarely beautiful thing with its classic public rooms, its long vistas, and its vast dimensions, that private corporation built, within a niche of the great waiting-room, a bronze figure of its former president, the late A. J. Cassatt, where all hurrying humanity might see it. But, though a thousand nervous travellers see that statue in the passing of a single hour, not a hundred of them will know the splendid tragedy it represents; for many of the high officers of that railroad — some of the men who caused the bronze to be erected — to this day believe that the production of that great station was the cause of the death of their chief. He had dreamed of that terminal for years; his engineer had deemed it all but impossible, and he had sent overseas for other engineers. One of these, who had conquered the busy Thames, said that he could tunnel the two great rivers. He was asked the cost, and he gave it. His first figures were staggering, but the railroad president did not abandon his hope. He summoned his board and put the problem to them.

There was pulling power between that president and his board, and the pulling was all in a single direction. Their system — a railroad that acknowledged no superior — could not keep in the very front rank without its terminal in the heart of the seaboard city, eliminating forever the delays and the inconveniences of a ferry service; the road could not afford to drop into second rank, and so it assumed the great undertaking.

That meant many things more than laymen understand; the selling of securities in delicate markets, home and foreign, which fluctuate wildly on the promulgation of anticorporation talk; the evading of untiring competitors; the appeasing of hungry politicians, only too anxious to feed at the hands of a wealthy corporation. In this case, it meant more than all these things, for the two rivers were quite as treacherous as the American engineers had pronounced them. They would sound in their tunnel bearings and find rock which seemed soft, and their dynamite charges would be sufficient. Then it would prove hard, and their blast as inefficient as that of a child's toy cannon. Again, the rock would drill as hard as the hardest gneiss — the very backbone of Mother Earth herself, and the hard-rock men would prepare a heavy charge of dynamite. Then the stuff was as soft as gravel, and their heavy charge would have torn off the roofs of half a dozen houses. When they were under one of the rivers they found its bed — the roof of their tunnel — as soft as mud. There came a day when the little foaming swirls of water above their headings became a geyser: the river-bed had blown entirely out.

After that, some of the younger engineers felt like throwing themselves into the wicked river, but the biggest engineer of all never lost his faith. He sent upstream and brought down a whole Spanish Armada of clumsy scows, each heaped high with sticky clay. That clay — in thousands of cubic yards — made a new river-bottom and the tunnel shields went forward.

There were other obstacles and discouragements, almost an infinite array of them, to be surmounted, but this railroad president had steeled his mind to the accomplishment of that terminal. In the making of it he gave his life. When the day came for the drafts upon the railroad's treasury, mounting higher and higher, he was cheer; when bad news came from the burrowing engineers, he was courage; when timid stockholders and directors began to

worry, he was comfort. He gave of his vitality to the organization, to the making of the terminal, until the day came when he gave too much — and his life went out while he was still like a mighty king in battle. He did not live to see the classic lines of the great station building. As he stands in the waiting-room, he stands in bronze. Those bronze eyes are powerless to see the splendid fruition of his endeavors.

That sort of thing — heroic courage and death-bringing devotion to an enterprise — repeats itself now and then among the executives of the railroads. When the panic of 1907 reached high tide, there was a certain railroad president who, like his fellows, viewed it with no little alarm. He had lunched with a big steel man, the kind the newspapers like to call a magnate, and the steel man had scared him. The company for which the former labored was going to close half a dozen of its plants — was going to throw some thousands of poorly provided men out of work.

The railroad president took that bad news back to his comfortable office; at night it travelled with him in his automobile to his big and showy house. It would hit his company hard in its heavy tonnage district, but that was only a single phase of the situation. He thought of things becoming more disjointed when the news became public — before that week had run its course. That night the president made up his mind to take a big step. It was risky business, but he thought it worth the risk.

He sent for the steel man in the morning and asked him what was the best price he could make for his product. The steel man cut his regular profit in half, but the president was not satisfied.

"You 'll have to show me a better margin than that," he said.

"We 'll eliminate profits," said the steel man, "and give you the stuff at cost, to save shutting down our plant."

"Is that the best you can do?" persisted the president.

Before he was done, the steel man had also eliminated depreciation on plants and half a dozen minor expenses. He agreed to deliver at the mere cost of raw material and labor. Then he received an order that would have broken some records in prosperous times. The road was committed to some big building projects and it needed whole trainloads of girders and columns; bridges by the dozen. The railroad president went further, and helped out the steel man's car-building plant. He ordered 3,000 steel freight cars, and every day he was getting reports from his general manager of a further falling of traffic tides. They had motive-power rusting on sidings, and they were dumping freight cars in the ditches along the right-of-way because they did not have storage-room for them. That took courage of a certain high-grade sort. When those freshly-painted new steel cars began to be delivered in daily batches of sixty, some of his directors asked him where he was going to find room to store them. He did not answer, for he did not know; but in the long run he won out. His company had a new equipment for the returning flood-tide of traffic which had cost it 25 per cent less than that of its competitors. When the time came to build its big improvement it had the steel all stored and ready. The president was able to tell his directors then that he had saved them $1,700,000 on that close bargain that he had driven in panicky times.

Sometimes a little thing makes a railroad president big. The head of a busy road in the Middle West was hurrying to Chicago one day to attend a mighty important conference of railroad chiefs. His special was halted at a division point for an engine-change, and the president was enjoying a three-minute breathing spell walking up and down beside his car. An Italian track laborer tried to make his way to him. The president's secretary, who was on the job, after the manner of presidents' secretaries, stopped the man. The signal was given that the train was

ready, but the president saw that the track-hand was crying He ordered his train held and went over to him. The story was quickly told. The track-hand's little boy had been playing in the yards and had hidden in an open box car; so his small companions had reported. Afterwards the car had been closed and sealed by a yardmaster's employee. Somewhere it was bumping its weary way in a lazy freight train, while a small boy, hungry and scared, was vainly calling to be let out.

Perhaps that president had a boy of the same size — they always do in stories; and perhaps — this being reality — he did not. But he stopped there for three precious hours, at that busy division point, while he sent orders broadcast to find the boy, orders that went with big authority because they came from the high boss himself. He was late at the conference, because that search was taking his mind and his attention. He hung for hours at a long-distance telephone, personally directing the boy-hunt with his marvellously fertile and resourceful mind. When action came entirely too slowly he ordered the men out of the shops and all interchange freight halted, until every one of 12,000 or 14,000 box cars had been opened and searched. Finally, from one of these they drew forth the limp and almost lifeless body of a small boy.

The railroad chief died a little while ago and was buried in a city 500 miles away from the line that he had controlled. The track-hands of his line, with that delicate sensibility that is part and parcel of the Italian, dug deep into their scanty savings and hired a special train, that they might march in a body at his funeral.

It sometimes takes a big man to do a little thing in a big way.

Here is Underwood, the railroad president who took hold of the Erie when the property was a byword and a joke, who began pouring money into it to give it real improvements and possibilities for economical handling,

and made it a practical and a profitable freighter, a freighter of no mean importance at that. He once issued an order that any car on the road (no matter of what class of equipment) with a flat wheel should be immediately cut out of the train. The order was posted in every yardmaster's office up and down that system.

Some time after it went into effect, Underwood was hurrying east in his private car. It was essential that he should reach Jersey City in the early morning, for he had a big day's grist awaiting him at his office. A real railroad president, working 18 hours a day, can brook few delays. But when the president awoke, his car was not in motion; the foot of his bunk was higher than the head. He looked out and found himself in a railroad yard three or four hundred miles from his office. When he got up and out he saw why his bed had been aslant. The observation end of his car was jacked up and the car-repairers were slipping a new pair of wheels underneath it. A car-tinker bossed the job and Underwood addressed him.

"Who gave you authority to cut out my car?" he asked.

"If you will walk over to my coop," said the car-tinker, politely, "you will find my authority in orders from headquarters to cut out any car (no matter of what class of equipment) with a flat wheel."

When the new wheels were in place the president of the road put his hand upon the shoulder of the car-tinker and marched him uptown. The man obeyed, not knowing what was coming to him. Underwood walked him straight into a jeweller's shop, picked out the best gold watch in the case and handed it to the car-tinker.

"You keep right on obeying orders," he said.

The relations between a railroad president at the head of the organization, and some man who struggles ahead the army of which the president is general, would make whole book. They still tell a story in Broad Street

Station, Philadelphia, of Mr. Cassatt, the Pennsylvania's great president, and the brakeman.

It seems that one of the suburban locals that took Cassatt to his country home up the main line was halted one night by an unfriendly signal. The president, mildly wondering at the delay, found his way to the rear platform. On the lower step of that platform, in plain violation of the company's rule, sat the rear brakeman. Cassatt was never a man who was quick with words, but he said in a low voice:

"Young man, is n't there a rule on this road that a brakeman shall go a certain distance to the rear of a stalled train to protect it by danger signal?"

The brakeman spat upon the right-of-way and, without lifting his eyes from it, said:

"If there is, it 's none of your damn business."

Cassatt — the man who could strike an arm of Pennsylvania into the heart of metropolitan New York at a cost of many millions of dollars — was much embarrassed.

"Oh, certainly it is n't," he said with an attempt at a smile. "I was merely asking for information."

The next morning the president of the Pennsylvania summoned the trainmaster of that suburban division to his desk and reported the matter. The trainmaster turned three colors. It was *lèse-majesté* of the most heinous sort. He proposed the immediate dismissal of the offending brakeman. Cassatt ruled against that. He was too big a man to be seeking to rob any brakeman of his job.

"Just tell him," he said to the trainmaster, with a suggestion of a smile about his lips, "that he cussed the president, and that, as a personal favor, I should like him to be more polite to passengers in the future."

No two railroad presidents come up to their problem in quite the same way. Take the two members of the Western railroad world — one gone now — Hill and Harriman. In J. J. Hill's domain the personality of the man *counts for* everything. He picks his men, advances them,

rejects or dismisses them, by a rare intuitive sense, with which he judges character. A high chief in his ranks once asked for a vacation in which to take his family to Europe. Hill granted it. When the man came back from Europe another was at his desk. Hill did not approve of long vacations, and that was his method of showing it. The department head should have known better.

On the other hand, Harriman measured his men impersonally — as if in a master scale. He measured them by results. A man might personally be somewhat repugnant to him, but if he accomplished results for the road, he held his place, at least until some one came along who could do even better.

W. C. Brown, of the New York Central, and James McCrea, of the Pennsylvania, are the heads of two railroads great in mileage and in volume of traffic; yet their methods are in many essentials radically different. McCrea is the essence of Pennsylvania policy — coldly impersonal. It is easier to gain an audience with the president of the United States than with the president of the Pennsylvania. No Pennsylvania man from president down to the lowest ranking officer, grants an interview to a newspaper reporter. It would be risky business for any officer of the Pennsylvania to have his photograph published or himself glorified by reason of his connection with the company. The company is the corporation.

When it speaks, it speaks impersonally through its press agent, a clever young man with clever assistants, who both answers newspaper questions and advances newspaper information. His function is a new one of the American railroad, and allies itself directly with the office of the president.

W. C. Brown, of the New York Central, probably stands preëminent to-day among American railroad executives. He has shouldered himself up from the ranks of the railroad army, and only good wishes have gone to him as he has stepped from one high post to a still higher

one. He has come, as nine out of ten successful executives have come, from the operating end of the railroad.

Brown is particularly accessible to newspaper reporters. He talks with them, carefully and painstakingly, and sees to it that they are correctly informed as to each of the great railroad problems of the day. He believes sincerely that the head of a railroad should be personality and that the personality should stand forth directly in the guidance of the property. In his own case, at least, he has demonstrated the value of his theory.

For all this work and all this strain, the railroad president demands that he be adequately paid. He has a good many perquisites — chief among them a comfortable private car at his beck and call; but perquisites are not salary. The head and front of the American railroad to-day receives anywhere from $15,000 to $75,000; an astonishingly large percentage of railroad presidents are receiving at least $50,000 annually. But they work for their pay — sometimes with their life-devotion, as in the case of the big man who built the big terminal; other times with the hard sense of the president who bought his steel girders and cars in the time of panic. Here is a case in point.

A road in the Middle West, which was so compact as to make it quite local in character, had a big traffic proposition to handle and was handling it in a miserable fashion. One local celebrity after another tackled it, until the directors were laying side bets with one another as to the precise day when the receiver should walk into the office. Finally, Eastern capital, which was heavily interested in the property, revolted at the local offerings, and sent out an operating man with a big reputation to take hold of it.

The directors received him with a certain veiled distrust as coming from another land, but in the end they hired him. The matter of salary came up last of all.

"*Fifty* thousand," said the New Yorker in a low voice.

One of the local directors spoke up.

"Fifteen thousand!" said he. "It 's out of the question. We 've never paid more than twelve."

"So I should imagine," was the dry response. "But I said fifty, not fifteen."

The consternation that followed may be imagined! In the end the New Yorker carried his point. At the end of just twelve months he had, through his acquaintance in Wall Street, and his keen insight into the big channels of finance, cut that little road's interest charges just $800,000 a year. The receiver has not come yet. The road has accomplished a miracle and has begun to pay dividends. There is another miracle to relate. Last spring, the directors of the road voted an increase in salary to their president — and he courteously refused it!

"I think the presidency of this road is worth $50,000 a year," he said, frankly, "and not one cent more."

That is the way a president should stand above and with his board.

Only a little time ago, another president, who had no easier proposition to set upon its feet, was criticised by a querulous old director for his lavish use of private cars and special trains. That president was having his own troubles — his job had no soft places; but he said nothing when the testy old fellow lectured him as he might have lectured a sin-filled schoolboy. When the director was done, the president spoke in a low voice.

"Gentlemen, my resignation is on the table," was his reply to the censure.

The next moment there was consternation in that board. The president slipped out of the room and left them to consider the matter. When he returned, the chairman of the board, who had nodded in half approval at the censure, was at the door to greet him.

"We refuse to accept your resignation," he said; "but the board does feel that you ought to have a new car — the present one 's getting shabby, Phil."

And in that moment the president felt that his work had gained one little *ounce of appreciation*.

CHAPTER XI

THE LEGAL AND FINANCIAL DEPARTMENTS

FUNCTIONS OF GENERAL COUNSEL, AND THOSE OF GENERAL ATTORNEY — A SHREWD LEGAL MIND'S WORTH TO A RAILROAD — THE FUNCTION OF THE CLAIM-AGENT — MEN AND WOMEN WHO FEIGN INJURY — THE SECRET SERVICE AS AN AID TO THE CLAIM-AGENT — WAGES OF EMPLOYEES THE GREATEST OF A RAILROAD'S EXPENDITURES — THE PAY-CAR — THE COMPTROLLER OR AUDITOR — DIVISION OF THE INCOME FROM THROUGH TICKETS — CLAIMS FOR LOST OR DAMAGED FREIGHT — PURCHASING-AGENT AND STORE-KEEPER.

AT the very elbow of the railroad president stands the general counsel. He is shrewd, resourceful, diplomatic. He has quick perception and action, the faith and the loyalty of a friend. In many cases he is a personal officer of the president — in the highest sense. If there is a change of administration of the railroad, there is apt to be a change in the office of the general counsel. If B——, who has been guiding the destinies of the T. & S., goes to Transcontinental, he is apt to take Y——, his general counsel along with him. For except in the case of some exquisitely organized roads like the Pennsylvania, for instance, the general counsel is in every sense personal to the president. He advises him privately, urges him to this step, cautions him from that.

On the other hand, the general attorney is more apt to be the legal officer of the railroad. Like the general counsel he has an old-fashioned pride in his profession that makes him hesitate at accepting a vice-presidency; he likes the ring of "general attorney" or "general counsel" in his own ears. Railroad history and tradition both go to prove that. He will hardly drop those titles for anything *less than* that of president.

The general attorney, unlike the general counsel, in most

ases will make his offices in the railroad's headquarters. He will handle its litigation, and if in half a dozen years he can bring down its verdict costs from $1,250,000 to $750,000 for an average twelve month, as one man did, he will be well worth the large salary that he demands and gets. And his salary will be only one of many of the heavy expenses of the legal department. When that functionary asks for money he gets it and without many questionings. The operating department, the traffic department, the engineers, may have to give sharp account for their appropriations; the legal end of the railroad is trusted to accomplish accurate results, without detailed accounting. In some cases it might prove embarrassing.

You want to know the value of the shrewd and perceptive legal mind to a big railroad? Here is a case that proves his worth:

A certain transportation company in the East had a legal vice-president who many people supposed was a political heritage to the road, a man for whom it was supposed a berth had been made by the owner of the property, who was something of a politician himself. A quick turning of the wheel of fortune had thrown one political party out of business at the capital, and another in. The man was given a place in the railroad offices, and a little later was made a vice-president. It so happened that the vice-president knew more than supposers might even imagine; but he was a quiet man, and sometimes some of his own clerks wondered why he drew his big salary. After he had been at his desk a dozen years they found the reason.

In gathering up a number of railroad properties to make the parent company — after the fashion of modern railroad practice — one of the most important of these old-time units was found to be in woefully shabby physical form. It was a valuable road in the consolidation. The new parent was willing to guarantee an annual rental

of 10 per cent on its stock; but as a railroad it fairly shook at the knees. It stood in dire need of reconstruction, and the men who were offering it a high rental made that a provision of the deal. The old road finally agreed to spend $12,000,000 in revising its line and in buying new locomotives, cars, and bridges. With much ado it accomplished its revision, and brought itself up closer to modern standards of railroading.

A decade later when the governmental supervision of the railroads had come into the full flush of its authority, the quiet vice-president had an armful of State commission reports and vouchers brought to his desk. He locked himself in his room, and in a week he had made from them a 20,000-word abstract in long hand. Then he took his report in to the president of the road.

The acute mind of that general counsel — you see that he was vice-president in this particular case — searching here and there and everywhere, had discovered a mouse-hole. The old-time road had not fulfilled its part of the contract. It had found that it could revise its lines at a cost of a little less than $9,000,000 and had quietly pocketed the change. The big rent-paying consolidation went into the courts, after its cool, impassive way. The case went to a referee and the referee took four years to hear the case and decide it. There were 5,000 exhibits offered in evidence and 8,000 closely written pages of evidence, making a case nearly equal to that of the receivership of the Metropolitan Street Railway Company of New York City, which fills twenty pudgy volumes of some 800 pages each.

The referee decided in favor of the parent company, and rendered a verdict close to $6,000,000, principal and interest. The case was appealed, and sustained. That vice-president had proved his worth. The president of the defendant road came to him.

"We simply can't pay," he pleaded. "We 've no *reserve fund*."

"Then we will take it out of your rental," was the emo-ionless reply of the quiet vice-president.

That type of man stands forth as a possibility to every one of the dozens and dozens of young men who make the main staff of the railroad's legal department. Those fellows come to the railroad fresh from the law schools. Their salaries are small but their experience and their opportunities are enormous. It is a far better career at the beginning than a briefless existence in one's own office, even though one's own name is emblazoned in brilliant gilt letters upon the door. A young man coming into the legal department of a large railroad has a diversity of work offered him. He draws up the simplest of papers at first, acts as assistant to a trial lawyer, then finally comes to the time when he will alone fight the railroad's case in some minor cause in a small court. After that the causes get bigger, the courts more important, he begins to delve into law libraries and to write briefs. Gradually he emerges into a full-fledged lawyer. He may eventually become general attorney or general counsel, and he may find himself welcome to the partnership of some really important law firm. He has knowledge that may be of value in fighting the railroad; whether he will use that knowledge in afterwards fighting his employer is a matter for his own conscience to determine.

There are special departments under the main heading of the law department. Counsel, the ablest of counsel, is retained at each important point reached by the railroad, and these counsel must act in conjunction and coöperation with headquarters. Special tax counsel have an important office by themselves, for the railroad sometimes finds itself in a difficult position. In its pride it may announce to the world, through the newspapers, that the new Bingown depot has cost $400,000, but when the Bingtown appraisers come around, possessing in their bosoms no inherent love for the railroad, those newspaper clippings in their hands, the tax counsel begins to earn his salary.

In these days of Federal and State supervision and r
lation of railroad management, with now and ther
aldermanic chamber or a county board of supervisors tr
its hand at the game, there is sure to be special cou
generally known as the commerce or commission cou
assigned to the complaints and hearings. For intricate
volved, or unusual cases the road may go outside o
own ranks and hire special counsel — lawyers who
specialists in the very thing involved.

Just as the big and tactful attorney stands back of
railroad's president, so there crouches at his feet the cl
agent of the company, who is its watch-dog and its sc
ing hound. Back of this claim-agent, who must h
achieved a reputation for keen-sightedness and mar
ability before receiving his position, is a busy compan
claim agents, at headquarters and every division h
quarters upon the system. Together, these form a r
tant organization that stands with the legal departm
to defend the railroad's treasury against indiscrimi
raiding.

Sometimes, because the work dovetails in many w
closely with that of the operating department, these cl
agents work under the order of the general manager
the division superintendents. A sly old fellow who c
headed a big road in the Middle West once explained
reason why — in the case of his property — without e
a trace of a smile.

" John says," he was speaking of his own general c
sel, " that a claim-agent can't be yanked up before an
these touchy bar associations and charged with unpro
sional practices if we can show cases — that they 're
railroad men and not lawyers, at all."

That was an exaggerated case. As a rule, the yo
claim-agent has abundant need to be upon his met
The public, with an inborn itching against the corp
tion, keeps him upon that mettle. The man who has
a slight bump upon a railroad train — to make an

stance — hunts out the claim office at headquarters. He gets quick treatment and mighty courteous treatment. If he can prove himself in any way entitled to a reimbursement, he gets it — in cash upon the spot. Likewise he signs a release — a most ponderous and impressive document. When his "John Smith" goes upon that document he has, in its own magnificent phrasing "in consideration of money received" released the railroad company from all obligation to him from the beginning of the world, the fall of man and the decline of the Roman Empire up to the very moment of the signing.

He goes home, pretty well satisfied with himself. It was only a little bump at that. A twenty-five cent bottle of arnica had made him physically himself once again; and as for his suit, well, that was pretty well worn, anyway, and three dollars to a tailor would make it a good "second best" for next winter. He feels that the ten dollars that the railroad gave him was pretty abundant compensation.

But wait until he sees his neighbor. The neighbor almost froths at the mouth when he hears of the transaction — of the impressively worded release that was signed.

"You 're a chump," he says. "You could have gone to bed, stayed there a week and they would have been glad to give you a hundred."

After which the man looks upon his ten dollars with contempt and a feeling of injury, and becomes a corporation hater. Or perhaps he was really hurt and had some sort of a bill from his doctor and his druggist, lost time to be compensated at his job. The railroad has figured these together and paid him the sum, with the signing of the release as a necessary feature of the transaction. The thing was not very serious, we will say, in this instance also, and the hundred dollars that he received was really a fair compensation. Now watch the neighbor, who it happens is a pretty shrewd attorney:

"Let me take the case, even now," he urges slyly.

"I 'll get a verdict of five thousand for you, if you a wise, and we will divide the proceeds."

"But I 've signed their release," groans the other.

The shyster laughs in his face.

"You were drugged," he whispers, "drugged, and w will prove it."

That is not an exaggerated case. It is the sort of thing that the railroad's claim-agents are combating every day of the year; and then wonder not, that some of them finally lose the fine sense of honor, themselves.

And beyond this class of folk, is another — nothing less than criminal. There are men and women in this broad land who make a business of feigning injury, and make it a pretty astute business, too, so that they may dig deep into the strong-boxes of the railroad. The most dramatic of this particular brand of "nature fakirs" has been Edward Pape, the man with the broken neck. Pape has a most remarkable deformity and has not been slow to avail himself of it as a money-making device far beyond the figures that might be quoted for him by circus side-shows or dime museums. Pape makes a specialty of the trolley companies. He can so alight from a car, coming slowly to a stop, that he will fall and go rolling into the gutter. Instantly there is excitement and a group of men to pick up the prostrate form. He is found to be badly injured and is hurried to a hospital. There the internes discover that he has a broken neck. A marvellous set of X-ray photographs are made, and the railroad is usually willing to settle a large cash sum rather than stand suit. Within a week he will probably be away and practising his trick on some unsuspecting railroad.

"There was a time over in Philadelphia that was hell," Pape once told the writer. "I 'd just finished my fancy fall, and they got me into the sickhouse and rigged out most to kill. They put hip-boots on me there in bed, with their soles fastened to the foot-board and a rubber bandage under my chin and over my head. They put seventy-

THE FREIGHT DEPARTMENT OF THE MODERN RAILROAD REQUIRES A VERITABLE

five pounds in weights on a cord and a pulley-jigger to that bandage and it nearly killed me all day long. At night I used to wait until it was dark and then I 'd haul up the weights and put them under the blanket with me. Otherwise, I don't know how I 'd 'a' got my sleep."

Little things like the discomfort of hospital treatment and searching examinations by railroad surgeons do not seem to discourage these criminals. They take these as necessary hardships that go with their profession. Inga Hanson, the woman who impersonated deafness, dumbness, blindness and paralysis to win a heavy verdict from the Chicago City Railway Company, and who was afterwards convicted of perjury, was wheeled daily into the court-room in a chair apparently nothing more than a living, inert, shapeless mass of humanity, exquisitely trained to enact her role of deception.

Sometimes the claim-agents, working in conjunction with the railroad's secret service, have used the camera to great advantage. A farmer who lives in New Jersey drove into a seaboard city with a load of produce. At a grade crossing, a switch-engine overturned his craft, about as gently as such an accident could be accomplished. The farmer was lucky in that he was bruised, rather than seriously hurt. Then he saw a lawyer and learned that he was incapacitated for life by severe internal injuries. He entered suit for $25,000 against the railroad.

There was a case for the secret-service bureau of the railroad, and it took little time to find the right detectives, husky enough to get out into the fields and work for four long weeks as farmhands. When the Jersey farmer began haying that August, he found less trouble than he had ever before experienced in hiring low-priced help. He was able to get two big lads, who were hard workers.

It was a big hay year and the farmer was not averse to turning in to do his part of the work. He liked to be with the boys he had hired and one of them had a cam-

era that he could take "great" pictures with. He showed him some of the pictures that he took those August days on the Jersey farm. The farmer liked them immensely.

He liked them rather less when his attorney came down from the city one day, with prints of the same pictures that had been sent him by the law department of the railroad. The farmer was given a chance to withdraw from the limelight or else stand a criminal trial for perjury, with the penitentiary's gray walls looming up behind. He took the chance. Few of the dishonest claimants will proceed after such evidence has been put before them. As for the railroad, it usually works better through getting signed confessions of guilt than by going through the somewhat intense workings of a criminal trial.

The secret service stands just back of the claim-agents. It has greater or less recognition in the case of different railroads but its work is generally much the same. It is police. Sometimes it is organized like the police department of a small city, with captains and inspectors at various division headquarters, and at other times its very existence is denied by the railroad heads. But its work is much the same. Its men, generally chosen for fitness from city police or detective staffs, sometimes root out tramps or small thieves along the line and in the freight-yards, sometimes in gay uniform patrol the platforms of crowded passenger terminals, sometimes work with greatest secrecy in "plain clothes" — which in this case may be jeans or overalls — to detect theft or treason among employees, and sometimes they receive their greatest laurels in connection with the "fake" suits that are brought against the railroad.

The secret-service works night and day. Its members, with the claim-agents, are at the scene of a serious accident as quickly as the wrecking-train itself. Together with the railroad's own corps of surgeons, retained in every important town, and chosen for absolute honesty and in-

tegrity, they form an important adjunct of the personal injury claim service.

The financial officer of the railroad is, of course, the treasurer. It is he who receives its earnings — running possibly into a hundred millions dollars in the course of a twelvemonth — and disburses them for supplies and for wages, for taxes and for bond coupons, and, it is to be hoped, for dividends. He works through appointed banks; and the bank president who can go out and capture one or two good railroad accounts for his institution has earned his salary for several years to come. The selection of the banks is one of the dramatic phases of the inside politics of railroading; it is a cause of constant wire-pullings and heartburnings.

"Do you see that whited sepulchre down there?" a big railroad head laughs to you as he points to a white marble skyscraper closing the vista of a city canyon. "This road built that temple of business. Our account is its backbone. Sometimes we deposit a million dollars a day and it is no uncommon thing for our balance there, approaching coupon or dividend times to reach sixteen or seventeen million dollars."

He laughs again, then grows confidential.

"We 're in a bit of a hole," he admits. "Some of the big manufacturers downtown are organizing a bank, and it looks as if it was going to be a pretty solid sort of institution. They want a big account from us, and our traffic people are urging their cause. In the long run they 'll get the account."

Then he explains to you that the railroad endeavors to hold down its bank accounts, although it must have them in a large number of different cities, to avoid the long shipments of large quantities of money. The agents and the conductors will, following a carefully arranged system, send their receipts to the nearest designated banks, mailing memorandum slips of the deposit both to the treas-

urer and to the comptroller. The bank in its turn, sends receipt slips to both of these officers, so the deposit transaction is hedged about with a sufficient degree of formality and detail.

When it comes to pay out its money, the railroad has no lessened degree of formality and detail. For the wages of its employees — generally the greatest of all expenditures — the railroad has proper system and order. The paymaster makes out the voluminous pay-rolls, they are each properly attested by the heads of departments; and for his pay-roll totals, the necessary vouchers are issued to him by the treasurer. He may pay the railroad army by check or he may send his deputies out over the system in the pay-cars.

The pay-car is one of the pleasantest of the surviving old-time railroad customs. The shriek of the whistle of the engine that hauls it is the pleasantest melody that can come to the ears of the man out upon the line. To shuffle in a long line up to its platform window where the railroad's money is being paid out in tiny envelopes, as each man signs the impressive roll, is one of the greatest joys that anticipation can hold out. As the car makes its routine trip over the line each month or each fortnight, it draws its money from the various repository banks, or else the cash is forwarded to it at division points from headquarters.

But, like many old customs, the pay-car is disappearing. The railroads are more and more paying their men by check. It is a better system in many ways. It avoids the handling of large sums of money, and many of the men prefer not to have a roll of bills thrust into their hands. The old prejudice among them against checks is practically over. The checks are constant incentives toward saving, the small banks in the little town are shrewdly reaching for the accounts of the thrifty railroaders. There may not be much for the bank in just one of these accounts, but they can quickly multiply into considerable sums.

We have already spoken of the comptroller; he is called the auditor upon some of our railroads. The comptroller is the most passionless and unemotional of all railroad officials. He measures the worth of his fellows by cold mathematical rules, by addition, by subtraction, by multiplication, by division. Even as big a man as the president may shudder at the result of such coldly accurate measurings.

No moneys are received, none spent, without the knowledge and approval of the comptroller. He is really a fine balance-wheel of the system, a governor working in exact accord with the laws of the ancient and wonderfully accurate science of numbers. By his computations men rise, men fall. He is the keeper of the rule and keeper of the weight.

His office organization reflects his own measure of accuracy. As a rule, an auditor of disbursements and auditors of tickets and of freight receipts report are his chief assistants at headquarters. A corps of sharp-eyed young men, each also having an almighty respect for mathematical accuracy, will be up and down the line for him, catching up careless agents on the one hand, and on the other gently showing them how to keep their accounts better, and conform more carefully to the company's established standards. Sometimes the car accountant, a man who watches the mileage of the company's cars travelling over other roads, and the equipment of other roads scurrying over the home system, reports to the comptroller, oftener, however, directly to the operating department. All these make a considerable office — an office which usually treads its monotonous path and rarely becomes nervously excited; an office to be well considered in the organization of the railroad.

The work of that office falls quite naturally into three channels — as we have already indicated — passenger receipts, freight receipts and disbursements, and general accounts. In the passenger receipts the accounting has, of

course, to do with the sale of tickets, and the cash fare collections made by conductors upon the trains. This would be simple enough bookkeeping if a good many years ago the interline or coupon ticket, entitling the bearer to ride upon several different roads, had not come into popularity. To apportion the revenue of a ticket between the half-dozen different lines upon which it has been used requires almost no end of system and accounting. Once a month each road has an accounting with its fellows, with whom it is engaged in selling through tickets. The coupons themselves are the vouchers, and cash balances of a single road — because of the freight as well as the passenger business — may be kept standing in the treasuries of several hundred other roads. It is a system quite as intricate, in itself, as the relations between city and country banking and yet it is only a single small phase of the conduct of the railroad.

The auditor of ticket receipts must also, through this staff organization, make sharp examination of the tickets that are turned in by the conductors at the end of each day's run. He must see to it that the conductor is neither careless nor anything worse. In either of these cases he will bring the matter quickly to the attention of the operating department.

In addition to the railroad selling its tickets there are also railroad passenger traffic organizations, half a dozen or more important ones across the country, which are engaged in selling various forms of railroad transportation. In some cases this takes the shape of a mileage-book which may be honored by fifteen or twenty different lines. The book will perhaps be sold for $25.00 and will permit of 1,000 miles' riding at a saving over local fares, if the purchaser comply with its provisions. If he has complied with its provisions within the year's life of the book, he will be paid $5 rebate upon return of its cover which has given him his riding at two cents a mile. Sometimes these books take the form of " scrip " which is silent upon

mileage but which has its strip divided into five-cent portions, sold at wholesale, as it were, at a fraction less than five cents each.

In any case, there is more work for the auditor who handles passenger receipts, and if the railroad is in New York State, for instance, where there is quite a model law in effect regulating these things he will have to be very careful how he handles the accounts for these peculiar mileage books. The law tells him that he must not credit the whole $25 to passenger receipts, for the law seems to point to even finer lines than the comptroller. He cannot even subtract the $5 which will probably return to the purchaser, and charge the $20 to receipts. The mileage-book sales must be credited to a separate account, and only transferred to the main receipts of the railroad as the strip is turned in for passage, a few miles at a time.

Do you wonder then that the comptroller sometimes grows gray-haired, that the vast routine of his office swells tremendously from year to year? The passenger receipts are almost always less than half of the income accounts of his offices. They are the A, B, C compared with the delicious tangle that comes when the freight waybills come in by the hundred thousand, and each little road must receive the last penny due to it. That feature alone will sometimes keep 400 clerks scratching their pens in a single office, will involve many, many more balances and cross-balances between the railroads.

And beyond that complication is still another, the constant investigation and settlement of freight claims that come pouring in against the railroad. There is another job for a staff of competent men. If it is an overcharge claim, the routine is comparatively simple. The audit office should have information at hand sufficient to decline the claim or settle it immediately. But if the claim is for lost or damaged freight, the thing complicates. Before the freight claim department will draw a voucher against the treasurer, it will have to assure its own

conscience that the claim is fairly substantiated by the facts.

From these receipts, combined with those from rentals of express or telegraph privileges or the like, the railroad pays its bills — pays its men, as we have already seen. It pays its taxes and its bond coupons and its fire insurance, and apportions these as far as possible over the twelve months of the year that it may keep a fairly even balance between receipts and expenditures. The other bills are paid by properly signed and attested vouchers, which are bankable like checks, and which are indeed the very best form of check, because they are upon their face a receipt stating the precise reason for which a certain sum of money was paid.

In recent years the comptroller, or the auditor, as you may prefer to call him, has become more and more of a statistician. He prepares tables as to locomotive performances, obtaining his figures from the mechanical department; he can tell you to an ounce the average carload of the system for any given month. He fairly seems to revel in his own development of the science of numbers. Train and car statistics will probably show the number of trains of different classes, the mileage of the same, the mileage of empty and of loaded cars, and the direction of their movement. Locomotive statistics run to mileage, consumption of fuel and of stores, and the cost of labor and material for repairs. In addition to all these the comptroller will probably prepare statistics of locomotive performances — so many miles to one ton of coal and one pint of oil. Then he will show the average cost of coal by the ton and of oil by the gallon, for the railroad never forgets the cost.

It is cost that really makes the excuse for these great statistics; cost and revenue, analyzed and reanalyzed in half a hundred different ways. The statistics are the thermometers, the very pulse by which the health of the *railroad* is acutely judged. Sometimes the statistics be-

come graphic, and the comptroller, through some of the keen-witted men in his office, prepares charts, in which statistics become "curves of averages" or jotted and wriggling lines, with each jot and each wriggle full of meaning.

"Government by draughting-board," sniffs the old-time railroader as he sees these great "cross-hatched" sheets with their crazy lines of intelligence spun across them, but it is "government by draughting-board" that has made the old-time railroader — well, the old-time railroader. The new-time railroader gives heed to those charts — the pulse readings of the creature that he is directing — guides his course in no small way by them. They are veritable charts by which he may pick his way quickly and safely.

Branching, as a rule, direct from the president's office and occasionally from the general manager's, are the purchasing agent and the store-keeper, many times one and the same, or the former acting as superior to the latter. The purchasing agent has no easy role. If he is not above sharp practices — the gift of a bit of furniture or a theatre box, in the least instances — he will fulfil only part of the reputation of his office; and if he is — as many, many of them are — absolutely honest down to the keenest degree of an acute conscience, he will probably still be under the suspicion of some querulous minds. His opportunities for deceit and guile are many, so much the more must he be an honest man in every full sense of that word.

He brings the modern railroad's passion for standardization down to the purchase of its every sort of supplies; for his office goes out into the market for anything, from a box of matches to a locomotive. The very fact that his department is a non-revenue department, save for an occasional sale of scrap-iron or discarded materials, only serves to put him the more upon his guard. He must not yield to the wiles of crafty salesmen. He must measure their wares by a single standard — economy, as expressed in selling-price, in durability, and in cost of main-

tenance; and upon that standard he must decide between them, as impartially as a justice upon the bench.

He must be guided by standard. If it be typewriters, he must struggle against the preference of this department or that for some particular machine, and bring all to the test of his three-headed economy. The successful machine will then be adopted for the system and brought as such. No small responsibility rests upon his accuracy of judgment.

His store-keeper must see to it that there is no waste of supplies. He must see to it, for instance, that the engineers are as careful in their use of oils as the clerk in that of stationery.

"We use $4,000 worth of lead pencils alone in the course of a single year," says one of them; "and if we did n't keep hammering at the boys, that figure would jump to $5,000 or $6,000 without realizing it."

He keeps check on the supplies that he issues. His stock of blank forms, alone, would do credit to a wholesale stationery house in a sizable city; for the railroad is a liberal user of printer's ink in its own devices. He must be thrifty and he must be economical; he must look to it that the railroad's money is not wasted in the purchase and use of its supplies.

Together with the general counsel, the general attorney, the claim-agent, the treasurer, and the comptroller, the purchasing agent and the store-keeper stand as guardians of the railroad's strong-box.

CHAPTER XII

THE GENERAL MANAGER

HIS DUTY TO KEEP EMPLOYEES IN HARMONIOUS ACTION — "THE SUPERINTENDENT DEALS WITH MEN; THE GENERAL MANAGER WITH SUPERINTENDENTS" — "THE GENERAL MANAGER IS REALLY KING" — CASES IN WHICH HIS POWER IS ALMOST DESPOTIC — HE MUST KNOW MEN.

THE general manager operating the railroad is held strictly responsible for the economical movement of the trains and the maintenance of the property. To the greatest portion of the railroad army (nine-tenths of it employed in the operating department) he is an uncrowned king. The superintendent, as we shall presently see, is the unit of the operation of the road, just as the division over which he is head is one of the physical units that go to make up some thousands of miles of first-class railroad track. The division superintendent deals in men; the general manager deals in division superintendents; and right there is the radical difference between the two.

The superintendent must see to it that his men get a square deal. If he does not see to it in the first instance they will see to it in the last, and woe to him if such be the case. For the men who work on the steam railroad are well-paid, well-read, keenly sensitive as to their privileges and their rights. And from these men have come the division superintendents, as different each from the other as men can be grown. It is the general manager's chief duty to bring these very different men into harmonious action. That is absolutely essential to the successful operation of the railroad. The general manager must have absolute firmness with his superintendents. He can appoint or discharge them as they can appoint or discharge their trainmen — more quickly in

fact, for up to the present time there is no brotherhood of railroad superintendents.

A certain division superintendent in the East had 150 miles of busy double-track trunk line under his direction. At his headquarters were a big classification yard and a coaling-station for the engine of the two divisions that intersected there. In the course of gradually increasing business, the coaling-station, which stood in a narrow ledge beside the main-line tracks and under the breast of a steep mountain-side, had to be enlarged. In so small a place, that was a difficult engineering problem. It was necessary to build much bigger coal-pockets and while the engineers were removing the old and building the new station, temporary coaling facilities had to be provided for the busy engine point. That part of the problem — more operating than engineering — was finally solved by going across the main-line tracks and locating a temporary coaling-station there. That made a bad situation — with the heavy main-line traffic constantly intersecting with engines drilling back and forth to their coal supply, and the general manager was quick to realize it. He went up there and warned his superintendent.

"This is a danger place," he said, "and a mighty bad one at that. That tower's too far away to guard this cross-over. I want you to put two flagmen here at all hours and let them personally signal and safeguard every engine that crosses these main-line tracks."

Then he went back to his own big office, feeling that the responsibility for that danger place was off his own shoulders, in part at least. The division superintendent put in the requisition for the four men he needed. The requisition enmeshed itself in the red-tape at the general offices of the system. Some smart young assistant auditor there, who could n't tell a coal-pocket from a gravity-yard, and who was 400 miles away, remembered that he had been ordered to cut the pay-roll — and the requisition went into *the* waste-basket. The division superintendent did not

to get another requisition for those flagmen through. : did the next best thing and told the towerman in the ›in — almost half a mile away — to keep as good a ıtch as possible of the cross-over.

The inevitable came early one evening, in an October g. The Chicago Fast Mail ran into an engine return-g from the coal-pockets and there were half a dozen ead when the wreck was cleared away. The division ıperintendent was hurriedly summoned down to the gen-ral manager's office.

"I cautioned you against trying to operate that cross-ver without special signalmen," that officer said, as he dis-harged the superintendent and so cleared himself of the sponsibility.

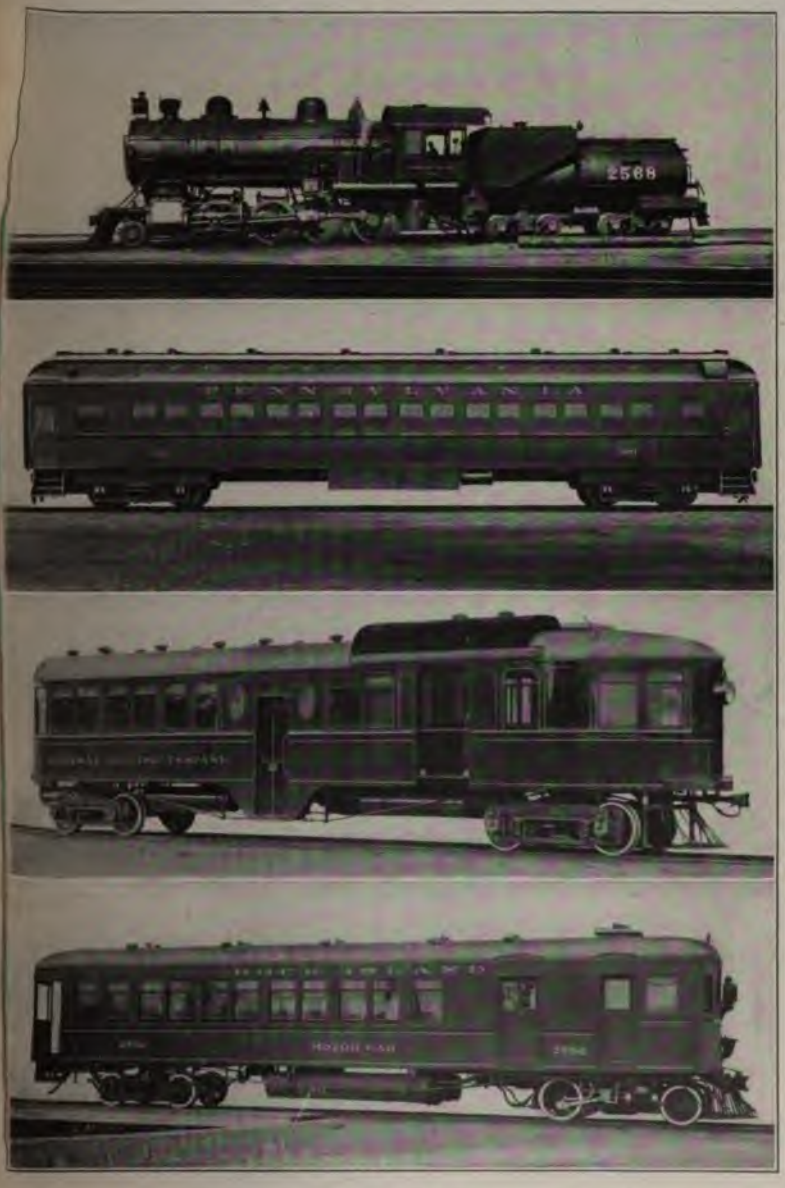
And that is where the modern system of excessive con-›lidation in our big land carriers turned one good, faith-ıl railroad executive into a howling anarchist. An illogi-ıl system has developed from this rapid expansion of ıe great individual railroad properties. As its most in-resting phase, it offers the man who is farthest away om the detail of operation as the man who decides. One an takes the judgment of another and both of them are .r removed, perhaps, from the seat of the very trouble at they seek to remedy. The man on the ground is pow-less in the matter.

Here is the yardmaster at a great interior railroad ntre — we call it Somerset for the sake of convenience. is is one of the biggest yards in all this land, and he is man whose judgment should be solidly respected. here are four improvements in his yards that he deems ›solutely necessary in the face of a rapidly increasing traf-; and for a portion of the property that depreciates rap-ly under hard usage. His is a most important position; ıd yet as he cannot spend a cent himself for the use of the ilroad, not even to buy matches, he embodies his four re-ıests for necessities into a requisition and forwards it to :adquarters — at a seaboard city. His superior officer

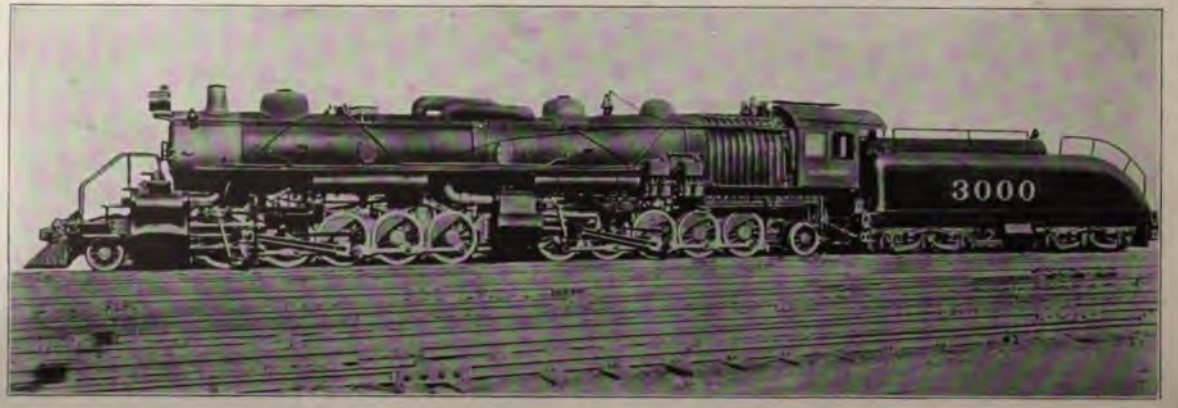
thinks that Somerset is asking a good deal, and he cuts the request down to three items. The next link in the chain is a man — an auditor, perhaps — who happens to be imbued with a strong streak of economy at that time. Middle division has had its appropriation cut thirty-three per cent. so off comes another item from Somerset yard. After a time, the yardmaster is lucky to get one single item through — and that is sure not to be the essential item that he needed most of all. Good, plucky, valiant railroader that he is, he is sure to think the whole outfit in the general offices a set of arrant fools. Perhaps the big accident comes, and then perhaps he has full opportunity to set himself straight. It is more likely that he does not, and that he is made the target for Grand Jury indictment and a lot of other fireworks.

That is an instance of the complications of the modern railroad — the vast intricacy of organization. Wonder not, then, that many a general manager of to-day must think twice before he remembers that some particular inland town is one of the obscure branches of his property.

The superintendent deals with men; the general manager, with superintendents. That statement is open to a slight modification. The superintendent deals with the operating army in individual cases; the general manager deals with them collectively. Somewhere in rank between the division superintendent and the general manager stands the general superintendent, but in the rapidly changing structure of American railroad operation, his office is fast losing its individuality, is to-day in real danger of utter extinction. On some railroads he is hardly more than a chief clerk to the general manager, a rubber-stamp whose signature goes mechanically upon papers bound upwards from division superintendent to general manager. At the most he is to-day an outside man, getting up and down the line and making constant reports to his boss, the general manager.



OIL-BURNING LOCOMOTIVE ON THE SOUTHERN PACIFIC SYSTEM
THE STEEL PASSENGER COACH, SUCH AS HAS BECOME STANDARD UPON THE AMERICAN RAILROAD
ELECTRIC CAR, GENERATING ITS OWN POWER BY A GASOLINE ENGINE
BOTH LOCOMOTIVE AND TRAIN — GASOLINE MOTOR CAR DESIGNED FOR *BRANCH* LINE SERVICE



THE BIGGEST LOCOMOTIVE IN THE WORLD: BUILT BY THE SANTA FE RAILROAD AT ITS TOPEKA SHOPS

For the general manager is really king of the entire situation. Just now his reign is threatened from a new quarter, and you find him receiving the opposition with both distrust and anger. This is the fine figure of a fine man. He has come up the ladder, rung by rung — station assistant, telegraph operator, despatcher, train-master, assistant superintendent, superintendent, general superintendent, general manager; he knows railroading, stick and wheel. His own railroad he knows as he might know the fingers of his hand.

When we come into his office, the last of a committee of well-dressed citizens is slipping out of his door; they are citizens from a prosperous town in an adjoining State, and he may tell us of their errand.

"K—— is a good town," he will say, "and gives us a good and growing traffic. We 've a lot of nasty grade-crossings there, for the two of our big lines that right-angle into there seem to get over about every street in the place at level. They want us to elevate or depress our tracks through there, and it should be done. This road wants it as much as K—— wants it; for it 's one of the worst bottle-necks on our main line, and Lord only knows how many thousands of dollars it 's cost us in delayed traffic."

This king of the railroad points to a sheaf of blueprints upon his desk.

"That tells the story," he says simply, "and the end of the chapter is a bill for nine millions of dollars to get rid of those crossings. According to law, K—— will have to stand about half of the cost of the work, and K——, like most progressive American towns, has been running pretty close to her debt limit. She is staggered at the thought of having to dig out three or four millions of perfectly good dollars, and so her mayor has made the naive suggestion that we advance the money and let them pay back their share in the shape of refunded taxes and annual payments.

"We advance that money — and the big boss has t slip over to France and try to sell our securities for me necessities. The truth of the matter is that we have n the money to advance. We 're grubbing to get enoug cash to buy locomotives and cars to keep pace with ou business, not running a loan business for upstart towi that have run through their capital."

In comes a second delegation, this one another grou of commuters. They have been asking for an addition train in on the Valley branch. The general manager h said that the road cannot afford it, for the train woul have to be operated at a loss. He proves his statemen

"But," urges the spokesman of the party, "you wi make traffic by it, and eventually the train will pay."

"Eventually is n't to-day," said the G. M. stanchl "and it is on to-day that we are being judged. Yo gentlemen come here and ask me to place a train in servi that is a sure loser; and then you will go down to you office, and when the difference between my net and gro comes to you upon your ticket sheets, you will damn m as being a rank incompetent."

"But this one train?" protests the spokesman.

"Violates that very principle," replies the general man ager. "Not another car that does not pay its way."

And as that little group files its way out of the big office, uttering sundry threats about going to the commis sion, the general manager stretches his leg over his big desk. Under the glass top of that desk is a big map, in colors, of his system — miles and miles and miles of first class railroad.

"They come to me — towns like K—— and tell m of their troubles," he says, "as if I already did not know of them. I 've a reconstruction plan for every ten mile of our main-line." His finger traces upon the map to a great division point. "Take Somerset here, and Somer set yard. That is some yard, as the boys say. We have *110* miles of track in it, enough for a good-sized side-line

division, and that yardmaster has to be the equal of a superintendent.

"You would take a good look at that yard, with its roundhouses and its shops, its gravity-humps and its classification sections, and you would think it big enough to handle every freight car that goes between here and Chicago. It is n't. It is n't really big enough to handle our decent share of that traffic to-day. We 're trying to pour the business through it to-day, and are succeeding only by the narrowest measure. It 's a weak valve in our biggest artery, and some day it 's going to clog.

"It won't be five years before Somerset has me throttled again. Five years ago it was as bad. It took us three to four weeks to put a carload of freight through it in winter, and the shippers were howling bloody murder. They got mad enough then to scare our directors and I got separate east-bound and west-bound classifications yards, relief that I 'd been fairly down on my knees for, three years at least. I was the goat in that thing. I always am; that 's part of the job of general manager.

"I know just what the steady increase in traffic is going to bring me to, at this point and at that. Here 's where a couple of our biggest feeders from the north come into our main-line; here are a couple of friendly haulers dumping down into us from Canada; here, in the mountains, is where we pick up our stuff from the south and the southwest. Every yard on our system is beginning to stagger under the traffic that shows no let up, and we 've got to spend millions to keep ourselves from getting throttled. Don't think I don't know every bit of that. I can see necessary improvements all the way up our main line; but every one of them takes money, and just now the big boss has to hustle to sell his securities and raise the money. But when we know and can't improve —that 's railroading."

A secretary tiptoes in. This railroad king looks up and smiles quite frankly at us.

"Committee from the Chamber of Commerce at Zanesburgh," he announces. "They want a new depot in Zanesburgh, and they 're entitled to a new one, costing at a fair ratio about $40,000. A $40,000-depot would give them every comfort and convenience but they demand that we spend $100,000 because Great Midland has spent $80,000 in an architectural wonder in Stenton; and the old time town rivalry makes Zanesburgh want to go Stenton one better."

"You 've got a lot of these delegations?" we venture.

"I lose track of them," says the general manager. "It 's all a part of the day's work; it 's railroading."

We know. Last night, this general manager was at a big freight terminal there in the headquarters city, seeing with his own eyes until midnight the fast freight and the express traffic under handling. The night before he was there, and the night before that he was also there, and three days before that he was out pounding over the line in his car, working eighteen hours a day. That 's railroading, too.

The freight house in this terminal city is one of his biggest problems. His biggest local freight yard is in a narrow valley between high hills; and these, together with fearful realty values, absolutely circumscribe its area. The traffic is growing all the while, and all the local freight for his road — running in strongly competitive territory — comes to this terminal. Three hundred and fifty cars must be despatched every night for different points, and yet a dray coming into the yard must be able to find any one of those cars without an instant's delay. And still the narrow physical limitations of that yard prevail. There is a big problem for a big man.

And sometimes the big man must stoop to examine carefully into the little things. When McCrea, the present president of the Pennsylvania, was a general manager off on the western end of that system, his car was halted in the middle of the night by a bad wreck on a single-

track side-line. He might have remained in his comfortable bed, but that would not have been McCrea. He got up and dressed, went outside and offered his services to the wrecking-boss. The wrecking-boss was competent and he knew it.

"There 's nothing you can do, boss," he said.

"Do you mean to tell me that there is nothing that I can do — with a road blocked on both sides with wreckage and stalled trains and track to be laid?" said McCrea. "Well, let me tell you that there are ties down there in the ditch that will have to be placed before another train goes over here, and we might as well be beginning."

And with that General Manager McCrea suited action to word. He went down into the ditch, picked up a heavy tie, put it over his shoulder, and brought it up into position. In an instant he was in the ranks, working to bring order out of chaos. That was the way a big man could do a little thing in a big way.

It takes a really big man for that very sort of thing. And the big man, general manager of several thousand miles of railroad, must understand the smaller men beneath him — any one of whom is apt in some future day to supersede him. Here is a man who has been known as one of the best general managers in the whole land. Soon after he was made operating head of a really big road, a certain train on which he was travelling was much delayed. The new G. M. inquired the exact reason for the trouble. He was not so much concerned for his own convenience as he was curious to know why one of the road's best through trains should have halted until assistance should come from the nearest roundhouse.

"The fireman lost his rake," was the somewhat perfunctory report that the G. M.'s secretary returned to him. But if that young man thought that his boss was going to be satisfied with that report, he was mistaken, decidedly.

"Bring the fireman to me," commanded the chief.

That fireman was not of the sort that is easily feaze He stood stockily and in a low voice gave a very circun stantial explanation of the whole occurrence. It seeme that he had missed the rake that morning when they ha started out from the yard roundhouse to take the Limite down over the division. He was just going back for an other, when they were called to lend a hand at a smal yard wreck. When they were done shoving and bunting there, they had no time to run back to the roundhouse and get a rake. They had barely enough time to get to the passenger station for the engine change. That was a good story, with a deal of explanation, and the fireman thought that the G. M. must be impressed with it.

The G. M. was not in the least impressed. He looked the coal shover up and down, from head to feet, then said:

"How about those seven freights that you passed laid out on sidings? You could have forced any one of those engineers to lend you his rake rather than lay out this train."

The effect of that slight observation from the G. M.'s car was not lost on a man on the system. The new man made good. From that time forward word went out to the far corners of his road that the "new boss" knew railroading; that he had four eyes in his head and that you had to be pretty careful what sort of a story you put up to him. Calculate, if you can, in dollars and cents the moral effect of such a stand upon the rank and file of the king's army. The general manager, as we have already said, must know men.

You are back with your first general manager again. He is tired of all these problems, and yet he is now turning to another. This is formally entitled the *Situation*. It is placed upon his big desk every morning. It is a morning paper, if you please, prepared for a single reader. The general manager is "Old Subscriber," in good meas

ire; and if the paper lacks both editorials and advertising, it is none the less interesting to its star reader. Its news is as exclusive as its reader, and exclusively the news of his system.

By it he knows first of the traffic that has been handled in twenty-four hours, by cars and by trains. He knows by it the reserve forces of the railroad, in cars and in locomotives, and just where they are located. By the *Situation*, he can discover the over-massing of equipment upon one division, the shortage upon another. After that he can begin to give orders to his general superintendents and his superintendents of transportation — these last the men who are directly responsible for car movement — toward bringing a better balance between traffic and equipment. The *Situation* is on his desk at ten o'clock in the morning. By eleven, whole brigades of locomotives may be under way, moving from their stalls in some giant roundhouse out toward another division whose superintendent is fairly shrieking for power.

But the *Situation* tells more than merely this. It goes into history, and in its own cold-blooded fashion tells what the road is doing by comparison. It gives weather conditions and traffic for the corresponding day, one year, two years, three years, five years before; and the general manager will do well if he avoids giving mere cursory examination of such tables. The *Situation* not only notes weather conditions, it brings to the eyes of the man whom we have called king in railroad operation the more important train delays and the reasons that have caused them. Every fact or incident that may affect the traffic or the operation of the road is noted in its fine-filled pages. It is in every way a guide and a barometer of the condition of a great property up to the very hour that the general manager comes to his desk.

But the *Situation* does not tell the entire story. Out in the nearest passenger yard is a big private-car, almost as handsome and as well equipped as that of the presi-

dent of the road, and that car is in service as many days as it stands idle there upon the siding. This man has 4,000 miles of railroad empire in his domain; there are nearly 70,000 faithful privates for his army. To cover that territory means constant travel. There are side-lines of less importance that sometimes do not see him for six months at a time.

Of less importance, did we say? We had better not let him hear us breathe that, for there are men in his employ who remember the first council of the operating department staff after this G. M. came to the road. They were gathered there for the time-table meeting — a general superintendent, a whole round dozen of division superintendents, serious traffic-minded folk from the passenger department, an auxiliary corps of chief clerks and stenographers. Division by division, the passenger time-table problem was adjusted. This superintendent asked a little more running time, for they were putting in a cluster of new bridges, which made slow orders necessary; another was thereupon forced to shorten his schedule, for the total running time between main-line terminals of a road in hot competitive territory could not be increased a single sixty seconds. Finally, after a vast amount of argument, the main-line divisions were settled, and attention was given to the side-lines. The first of these ran through a section purely rural, but there was not a busier 500 miles of single track in the East.

The general superintendent called attention to it, with a laugh.

"We 'll now tackle the hoejack," said he.

It was an old joke, and the division heads began to laugh. They stopped laughing the next instant. The new general manager was on his feet and pounding thunderously upon his table top. His face was crimson, as he demanded attention.

"Gentlemen," said he, scathingly, "the great railroad from which I have had the honor to come has prided

itself upon being a standard railroad. Its standard is universal wherever its cars and engines run, and its jurisdiction extends. Some of its lines are the busiest traffic-haulers in the land. The four and even six tracks to each of them are hardly enough for the great volume of high-class freight and passenger traffic that press upon their rails. There are some side-lines, with but two or three trains a day — side-lines that reach the main-line only through other branches. But there are no hoejacks, nor peanut branches, nor jerkwaters upon that system. Hereafter there are to be none upon this. The man who is hauling a train on the most remote corner of this railroad is doing its work quite as much as the biggest train-master here at the terminal. I trust you follow me?"

They followed implicitly; and to that general manager has been finally accorded the credit for bringing an operating department, torn by inefficiencies and by jealousies, into one of the first rank among the railroads of the land.

But he admits that he is going out upon side-line; and that particular side-line brings a story to the mind of his chief clerk. When he has us quite aside he tells it to us:

"The next to the last time the boss went up the Upper River Division, they got his goat. We halted at the depot up at West Lyndonbrook, to fill the tanks. The boss thinks that he will get out and stir his feet for a minute on the right-of-way. Up comes a villager. 'Are you the general manager of this 'ere road?' he says to the boss. Boss thinks he was some gentle bucolic soul, and he says 'yes,' and offers him a real cigar. But the gentle bucolic does n't smoke anything cleaner than a pipe, and he just up and says, 'Well, General, here 's somethin' fer ye,' and shoves a paper with a big red seal into the boss's hand.

"It seems that up in that neck o' woods they get grade crossings removed as a last resort by going to the county court and the paper that the constable served was one for the boss to come down there in a fortnight for a

hearing on an order to put a flagman and gates at our crossing in West Lyndonbrook. The boss was mighty mad, and almost discharged the agent for letting that constable hang around the depot. There is n't enough traffic over that line to do more than keep the rust off the rails, and we never had an accident in the sixty odd years that crossing has been in use. And at that the boss might have fallen for a flagman. But the way they rubbed it into him riled him. They might have gone at the thing in a decent way — first sent a committee down to the division superintendent to request that flagman.

"He went down on the appointed night to the old Town Hall. Before he got there he started a guessing contest in that smart-aleck burg. The crossing was right 'in the heart of the community,' as they put it themselves, and the big citizens' houses were all within an eighth of a mile of our right-of-way. Three days before the big flight of oratory down at the Town Hall, the boss starts something. They hardly get away from their houses in the morning before there is a bunch of those bright tech-school boys with their rods and sextants and steel tapes measuring lines over the front lawns. And the next thing they were planting bright new stakes in all the flower-beds. There had n't been so much excitement in West Lyndonbrook since the last time Theodore Roosevelt talked there, and the townfolk hustled down to the depot. The agent did n't ease their minds. The boss was n't working hand in glove with him.

"When the night came for the big time at the Town Hall, it was a regular 'standing-room only' business. The boss kept in the background while the great minds of the township did their best. When it came his turn he clamped across the platform like an avenging angel. He is a big fellow, and that night he looked seven-foot-six, as he stuck his long fingers out over that intelligent body politic and asked what it meant by trying to cow *the only* first-class railroad that had ever had enough

energy to put its rails down in that township. Then he calls up an engineer from our construction department.

"'Mr. Blinkins,' he says, in a voice that you could have heard across the public square, 'this railroad has decided to temporize no longer in this highway crossing situation on its lines. How much will it cost to put a subway under our track at this crossing?'

"The engineer dove into his drawings and said: 'It 'll be quite a big job, and we 'll have to cut quite a way into some of the front yards to get the foundations for our abutments. My estimate of the cost of the proposed improvement is $160,000.'

"Then it was the boss's turn again. 'Under the state law, work on abolishing a grade crossing begins by the railroad expressing its willingness,' he told them. 'The cost is divided — half being borne by the railroad, the other half being divided between the township and the State. West Lyndonbrook's share will reach $40,000.' Forty thousand dollars — why $40,000 would have built either the new union school or the waterworks that that burg had been hankering for and thought it could n't afford. When the boss breathed about that $40,000 it started the old feuds between the waterworks crowd and the school crowd. They forgot all about the crossing and our sin-filled railroad, and got to hammering anew on the old issue. We slinked out while they were still at it — had the car hooked on to the rear of thirty-eight and got started while the oratory was taking a fresh turn.

"The boss? The boss is a diplomat. That 's how he keeps his job."

CHAPTER XIII

THE SUPERINTENDENT

HIS HEADSHIP OF THE TRANSPORTATION ORGANISM — HIS MANNER O DEALING WITH AN OFFENDED SHIPPER — HIS MANNER WITH COM MUTERS — HIS MANNER WITH A SPITEFUL "KICKER" — A DISHONES CONDUCTOR WHO HAD A "PULL" — A SYSTEM OF DEMERITS FOR EM PLOYEES — DEALING WITH DRUNKARDS — WITH SELFISH AND COVET OUS MEN.

IF the general manager is king in modern railroad operation, the division superintendent is not less than prince. His principality is no mean state. It may consist of some 500 miles of what he modestly admits is the "best sort of railroad in all this land"; or it may be a little stretch of 100 miles, or even less, losing its way back among the hills; but it *is* a principality, and his rule is undisputed. If ever it be questioned, it will then be high time for him to abdicate.

Just as the division is the physical unit of railroad operation, so is its superintendent the human unit. By him the transportation organism stands or falls. If it stands, he is able to go forward; the path from his door leads to the general manager's office. If it falls — Well, there is to-day in Central Illinois a gray-haired station-agent who once held his own principality — 4,000 men to take his orders.

"We only discharge for disobedience or dishonesty," said the president of that railroad at the time he signed the order reducing the prince to the ranks. "When we fail to get the real measure of a man, it is our fault, not his. We never turn out a man who has done his level best for us."

This man is superintendent of one of the most prosper-

ous of the trunk-line railroads that reach the metropolis by stretching their rails across New Jersey. His is a "terminal division," so called, and he has assumed command of one of the busiest city gates in all America. His railroad day begins almost as soon as he is awake. There is a telegraph outfit in the corner of his bedroom, and as he dresses and shaves he listens mechanically to its scoldings — to the gossip of the division. It comes as casually to his ear as the prattle of his children; the key began to be music to him long before he left the little yellow depot where he first began to be a railroader.

"They 're in pretty good shape this morning, John," laughs his wife. She, too, has been listening half unconsciously to the gossip of the wire. Years ago she "stood her trick" with her husband back in that little yellow depot.

"Got a coal train in the ditch up the other side of Greyport," is his reply. "We 'll rip out that nasty crossover up there some day, when the big boss wakes up to the cash we 've put out in wrecks at GP."

"Going up there?"

"Not this morning, Maggie," he laughs. "I 've a committee from the firemen coming in to see me. They 're nagging for a raise." He lowers his voice, as if he almost thought that the walls had ears. "It 's beginning to grind the boys, too — butter 48 cents, eggs 45, and all their hungry kiddies. But the big boss — whew!"

He whistles, goes to his key, cuts in, and begins to give orders to the wrecking-boss up at Greyport.

"Steady, Jim," he says, in a low voice. "You 've got all day on that job if you need it, only watch out for the number two track with your crane. We can't risk a side-swipe on one of our pretty trains. We 're detouring the east-bound passengers over the Central. How 's Hinckley?"

He closes the circuit softly.

"Poor Hinckley," he says gently. "Do you remember, Maggie? He was married the same summer we were."

Through with his breakfast, he hurries down to the station, and before he slips aboard the suburban train that is to carry him in to his Jersey City office, he has had the wire again into Greyport. They are getting things cleaned up there a bit; a baggage-car has been sent up with a special engine for Hinckley. The superintendent turns from these. One of the little trains that come out from town in the dusk of early dawn has brought a leather bag filled with mail. He runs through it as his train slips across the meadows. By the time he is in his roomy office it is ready to be answered, a pencilled memorandum on each is sufficient guide for his chief clerk.

Throughout the morning his calendar is a crowded thing. There is a constant line of restless men sitting on the long bench just without the guarded rail of the outside office. One by one these are called; they disappear behind swinging baize doors to stand in front of the superintendent.

For the first of these there is a smile — the caller is a big shipper, big enough to go to the head of the line and have instant access to the boss. This shipper is the sort who gives the railroad tonnage in trainload lots. He is hot. He cannot get cars. He will begin to route over the Triple B——, even though his siding facilities are wrong for it. *They'll* dig him out the cars he needs, they have folks over there who make it their business to find cars. And while he is on the subject it seems pretty bad to have stuff coming twelve and fourteen days through from Chicago. Perhaps he'd better be getting after the Commission. The shipper is very hot. He expatiates upon his wrongs, hammers upon the superintendent's desk, grows scarlet in his heavy face.

The superintendent's smile never wavers. He gives attention, does not grow excited. A few orders

over the telephone, a word of explanation, the shipper smiles now. Down in his heart he begins to be sorry that he made these threats about the Triple B——.

That is getting traffic, you say, and the superintendent is an operating man. You are a bit wrong there. The superintendent is a *railroad* man and that means that any part of the railroad business is his business. There is a man, by name A. H. Smith, who is to-day operating vice-president of the New York Central system, who held to that idea from the beginning. In the beginning, Smith was the superintendent of a little side-tracked division of the Lake Shore & Michigan Southern which centred in at Hillsdale, Michigan. It was a strong competitive territory, and Smith found that the traffic that came to his road was so slight that it did not take a great deal of his time to move it. The superintendents before him had had a lot of time to speed their fast horses and fuss around their gardens. Not so with Smith. He went into the business of making traffic. It was a decade that took keen delight in singing societies, and Smith's robust voice allied itself to every choir of importance in three counties. He sang himself into personal popularity, he sang traffic into coming over the Michigan Southern. After a while, the folks over in the general offices at Cleveland began to take notice. The traffic folks were the first to notice, after that — well, a long story 's short when you know that Smith found himself on a short cut to his present job.

The superintendent's smile remains while a solemn-faced delegation of commuters files into his room. These grave folk have been coming into town on the 8:52 almost since the road first laid its rails. It is part of their lives, and they fondly imagine that it is a big part of the road's — that the twenty-hour train over the mountains to Chicago is a matter of considerably less importance than the 8:52. The superintendent broadens his bland smile and rings for his train sheets. There are other

trains than the 8:52 coming into that terminal — almo a train a minute from a little before eight o'clock unt half-past nine. The superintendent's finger runs for co roboration over the train sheets. Twenty-five days thi month when 94 per cent of his suburban trains come un der the protection of the big shed of the terminal right o the scheduled moment — how was that for consistency o operation?

The commuters' committee seem a little dazed. Individually, the men are expert on a good many things — printing, indictments, breakfast foods, patents, wholesale feathers; but consistency of train operation and train sheets are a bit confusing.

"The 8:52 has been late a whole lot recently," doggedly affirms the chairman. "Last Thursday we were pretty near fifteen minutes late."

A gleam of triumph comes into the superintendent's eye. He fumbles anew among the flimsy train sheets. His forefinger alights upon a line of the typewritten copy.

"Last Thursday," he comments, "you can see that we were all laid out by the Hackensack River draw. A schooner filled with brick got caught by the ebb tide and laid down on us in the open draw. What you want to see, gentlemen, is the Treasury departments down at Washington. It is outrageous that the antiquated navigation laws should be allowed to hold up business in that way."

The committee confer among themselves and decide to make the life of the Secretary of the Treasury uncomfortable for a while.

"You cannot hope for anything better with that Hackensack Bridge," urges the superintendent almost malevolently.

He does not tell them, but the boys out on the line know his own experience with the Hackensack River bridge. Last December and just in the evening rush-hours they found that the cabin that stands perched at

ıe top of the trussed draw was afire. The trains bring-ıg home the tired suburbanites were beginning to line up ıack of the fire for solid miles. The tired suburbanites vere saying things about this particular railroad. It hanced that this superintendent was a passenger on one ɔf the trains. He went forward to the blaze. The ɔwerman had beat a retreat. The superintendent started ɔ climb up the ice-covered ladder tower toward the ɔurning cabin. The towerman halted him. The wiry ıperintendent turned upon him with a look of infinite corn:

"We 've got to hand signal those trains across here — here 's thousands of folks out here in the meadows that ve can't let miss their supper —"

"I 've got a family —" began the towerman.

"That 's all right. I 'll signal these across."

"That ain't it, boss. Back o' th' cabin 's the gasolene anks, the stuff for openin' th' draw."

The superintendent gave a low whistle.

"That settles it," he said. "We 've *got* to put this ire out. I can't risk cutting this draw out of service."

It is a matter of record on that railroad that he climbed lone to the top of the draw and began to put out the ire with his own stout endeavors. He was not alone for ong. Inspired by him, the men that gathered there — ngineers, firemen, trainmen, and conductors, crawled up ıpon that freezing cold draw and lent him their efforts. ın a half-hour the fire was out, and the stalled trains were noving again.

This, then, is the measure of the man who sits across he wide office table from you. The mollified commuters ıre marching out.

"You don't encourage kicking?" you ask.

"We don't discourage it," he replied. He is reminded ɔf a story and tells it to you.

"When they made Blank superintendent over there at Broad Street, in Philadelphia, he went in to make a clean

record. He called his chief clerk to him. 'Mind you, if you hear kicks, don't let them get in one ear and out the other. You bring them in here and we 'll investigate.' In three days the chief clerk was busy. 'Lots of trouble with the suburban traffic to-day,' he would say. 'Wilmington train laid out at Grey's Ferry; third day that 's happened.' 'Ugly trainman on the main line would n't close the rear doors. That fellow 's unpopular.' 'Not enough equipment on the Central division.' 'No fire in the stove at Lenden Road,'— a long string of commuter troubles. After Blank had heard this for a week he began to get nervous. He called his chief clerk to him. 'See here,' he demanded, 'what 's the matter with our service? Where are all these kicks coming in from?' The chief clerk looked at him — never a snicker. 'You said you wanted the kicks,' he replied. 'Well, I 've been letting the head barber downstairs shave me after he was done with the commuters. He gets every one of the howls.' "

Sometimes the kicks represent a serious side of the superintendent's problem. A while ago a man came to a railroad superintendent in Boston and demanded that a certain ticket-examiner in the passenger terminal be dismissed. There had been some sort of dispute and the man insisted that the ticket-examiner be discharged, nothing less. The ticket-examiner, on his part, told a pretty fair sort of story. Moreover, he said that if in the heat of the dispute he had transgressed on good manners he was frankly sorry and that it would not happen again. Back of all that he had a good record: no complaints had ever before been registered against him. The superintendent then wrote a letter to the man who had complained and stated that the offending ticket-examiner had been reprimanded and that the offence would probably not be repeated.

That did not satisfy the man who complained. He was of the sort that are supposed to have a " pull," and

THE CONDUCTOR IS A HIGH TYPE OF RAILROAD EMPLOYEE

THE ENGINEER — OIL-CAN IN HAND — IS FOREVER FUSSING AT HIS MACHINE

RAILROAD RESPONSIBILITY DOES NOT END EVEN WITH THE TRACK WALKER

THE FIREMAN HAS A HARD JOB AND A STEADY ONE

he threatened to use his pull if the ticket-examiner were not discharged. He refused to accept apologies or explanations. He said he was hot. So was the superintendent. He keenly resented anything that approached interference with his discipline, and he refused to discharge his employee. Pressure was exerted, the pull was doing its fine work. The superintendent was — like every other railroad superintendent in this land — a fine diplomat. He took the man from the train gate in the terminal and gave him an equally good job in a city a hundred miles distant from Boston. He flattered himself that he had seen the last of the man with the pull.

Not a bit of it. That brisk soul chanced to pass through the distant town, and gasped at sight of the former ticket-examiner still drawing pay from the railroad. He hastened into the superintendent's office in Boston and demanded that the subterfuge end — that the man be actually discharged from the road's employ. The superintendent looked at him coolly, not speaking. The man again threatened his pull. The railroad boss looked at him through slitted eyes. It was a real crisis for him. His diplomatic smile was ready. He pointed with his lean forefinger toward the door.

"The case is closed. Good-morning," was all he said.

After that he began wondering what road would have him after that pull was exerted. He wondered for a day, for a week, then a month. Then he forgot the occurrence. The pull, like many other sorts of threats, was thin air.

Of a different sort was the problem that confronted a superintendent in Chicago. On a certain suburban train for many years the conductor had remained with an unchanged run. Gossip had come into the super's office that this conductor was systematically stealing from the company. The boss started a quiet investigation. The conductor with apparently no other income than his $3 a day, had purchased a neat home in the suburbs, had

sent his boy to Yale, his girl to Vassar. That was Thrift, with a capital T. The superintendent took the case sharply in hand and summoned the conductor before him. He was one of the older sort, gray-haired, kind-faced.

"Johnson," said the boss, "you 've been with the road a long time and never had a vacation. I want you to lay off a month and run over to either coast. I 'll get the transportation for you."

Johnson protested. He belonged to a generation of railroaders that was not educated to vacations. The superintendent insisted and had his way, as superintendents generally do. Johnson started on his vacation, and a substitute, knowing nothing of the real situation, replaced him. The returns from that daily run doubled, and the superintendent knew that he was right.

Nowadays when a railroad finds that a conductor is stealing, it invokes the majesty of the Interstate Commerce Law and prepares to hurry him off toward a Federal prison. In that day they were content to fire Johnson; that was sufficient disgrace to the old man. The railroad could not begin to get back the money that had been trickling out throughout the long years.

But Johnson showed fight. His was an important train in the Chicago suburban service, and his passengers were important merchants and manufacturers — big shippers. They got together, under Johnson's supervision, and made the hair on the heads of the traffic men turn gray. Those fellows were Johnson's friends, and they were not going to see the N—— turn out a faithful employee. Johnson said that he had not stolen, and Johnson was not the sort to lie. It might do the N—— good to send some tonnage over to the M——. The traffic department and the operating locked horns, as ofttimes they do on roads, both big and little. Traffic won. The superintendent lost, Johnson went back to his job, and the road put on a checking system that made its conductors wonder if they had held convict records.

That case was an exception. There are not many superintendents who are compelled to back water, mighty few Johnsons among the thousands of conductors across the land.

We are still in that superintendent's office in Jersey City. The boss's smile is gone. A big railroader just in from the line, his jeans covered with engine grease, shuffles into the place and stands before the super, hat in hand, like a naughty boy ready to be whipped. The superintendent speaks in a few low sentences to him, makes a notation on an envelope. The big man trembles in front of the little. A bit of a smile comes to the lips of the boss.

"You think of the wife and the kiddies first next time," he says. 'Good-bye and good luck to you.' I 'm not much for lecturings," he adds, after the man has gone. A little later he begins to explain. "That big fellow had to be disciplined. There was no two ways about it for either of us. He 's an engine-man, got a good train, too; but he 's been running signals. We 've caught him twice on test. We can't stand for that. Suppose we have a nasty smash and the coroner's jury begins to ask nosey questions? I had to put black on his envelope."

He goes into further detail. In other days he would have been forced, in order to uphold his discipline, to suspend the engineer for from five days to two weeks — the punishment preceding discharge. There was a possibility — disagreeable to the superintendent — that the engineer's family might have been crowded for sufficient food for a fortnight. Some of those fellows live pretty close to the proposition all the while. Nowadays the offender is demerited — once again like the schoolboy. That is what the superintendent meant by that reference to the envelope, the road's record of the man's service with it.

Sixty demerits — dismissed. That 's the rule of one big road. But the record does not always continue to

be negative. Its positive side rests in the fact that for every month a man keeps his envelope clear five demerits are taken from the black side of his envelope. A trainman might have forty-five demerits against him, be on the narrow edge of discharge, and in eleven months, after turning the new leaf, have as clean a sheet as the best man on the division. This is as it should be. The demerit plan — often called the "Brown system" — represents the triumph of modern railroad operation over the old.

The superintendent may have all the advantages of a time-tried disciple and a modern record system; have the prestige and the reputation that come from the operation of 500 miles of railroad, and still have a hard row to hoe. Out in the Middle West there was, until recently, a stretch of what was known as "booze railroad." It was a division where reputations and records alike counted for naught, where discipline was a mockery. Train-crews went from their runs direct to saloons and, what was a deal worse, began their day's work within them. The wreck record of that division that went forward to the State Commission was appalling — and half the wrecks were not reported. Yardmasters were busy day after day stowing away damaged equipment far from the curious eyes of passengers — the wrecking crews were hammering for big over-time pay. It was a thoroughly demoralized stretch of railroad.

The distressed president of the system sent East for a superintendent who had a reputation. He thought he had his man. The new broom was a book-of-rules man. He had a quarter of his operating force laid off all the time, to go before him. He was a man fond of words and he lectured those old fellows as if they had been school children. He might have done quite as well with his division if he had been operating it from Kamchatka. The men began to call their rule-books the "Joe Millers."

The superintendent got mad and was lost — hopelessly

He began discharging right and left, and the wrath of the gods and of the brotherhoods (the great labor unions of the railroads), was upon him. The road was threatened with a big strike at the very time that it could least afford it. He avoided that strike only by acceding to the demand of the brotherhood chiefs that the superintendent's head be given to them on a silver platter. After that the "Man Without a Country" was in a more enviable position. There was not a railroad in the country that dared employ him, despite his excellent technical training. He drifted up into Canada, got a job running a state-operated line. He held that job less than a year. He was murdered of a winter's night in a shadowy railroad yard, shot down by a discharged train hand.

The grim situation on the "booze division" grew much worse. The president of that system gave the matter his keen personal attention; he began scouring the entire width of the land for material, without much success. When he was thoroughly discouraged, a raw-boned trainmaster from a far corner of the demoralized division applied for the job of superintendent; he reckoned he could handle the situation. He had caught the president unawares standing outside of his private car. The president told him that he was superintendent.

"There was something in Matt's eye that took me," he confessed afterwards. "You do see something in a man's eye now and then that beats a whole barrel of references."

So Matt Jones (that is nothing like his real name), took up the nastiest operating proposition in the country. He did not lecture nor discharge, not he; but the men knew that there was a boss behind the super's desk. The fellows who began trifling with the new broom were down in his office the next morning. Jones selected the leading spirit; he had the advantage of knowing him.

"Pete," he said in a quiet way, "you 've been drink-

This superintendent has his division 400 miles away from New York, a clean stretch of busy railroad, making a link in one of the stoutest of the transcontinental chains, 300 miles of line, making traffic and handling it. The superintendent is a personage in the little inland city where headquarters are located; his opinion is eagerly sought by the local reporters each time a new civic problem is tackled. If he were in the metropolitan district he would be unknown except to a little coterie of railroaders; up here he is the voice of the railroad. He is far more real to the folk of half a dozen populous counties than is the president of the road, a stuffy gentleman who comes up in a private car once in a dozen years to the dinner of the local Chamber of Commerce and tells the townspeople to thank God that they have the main line of the K. & M. running through their "lovely little city."

You may listen for the clatter of the telegraph key in his house and be entirely disappointed.

"I would have poor system if I had to listen to all the gossip of the wire," he tells you quietly. "We 've organization on this stretch of line." He says this with a bit of pride. "We have men and we have system. My train-masters are in effect assistant superintendents: they are expected to organize beneath them."

Watch this sort of man. He is the kind that American railroading is hungry for to-day. Of him the big executives are being made each year. He enters his office in the morning and gets a few brief reports of the situation on the line: first weather, then congestion conditions in the big yards. After that he talks over the long-distance 'phone with the G. M., four hundred miles away. He gives a summary of the situation to headquarters, just as the summaries came in to him from his train-masters at junctions and at terminals. He holds the telephone receiver for a minute: the 'phone is rapidly coming into general railroad use since the telegraphers made Congress

pass a bill limiting their working hours to eight each day. That bill promises to make trouble yet for the men who were supposed to benefit by it.

The telephone speaks to him a moment. He hangs up the receiver and speaks to his chief clerk.

"W. H. T. is coming up the line this afternoon. Tell the boys not to get rattled," he says.

That is all. The passage of the President of the United States over his three hundred miles of well-ordered track makes no flutter in this superintendent's heart. If it were Europe — the troops would be drawn out, all other trains brought to a standstill, pilot engines run in advance of the royal train, in infinite pow-wow over the railroading of nobility. But it is not Europe, it is this blessed United States, partly blessed because it so excessively differs from Europe.

Only the military aides of the President lament upon the informality of his travel. Some time since a great executive was making the familiar loop throughout the West. The superintendent of a division of line the far side of the Missouri was a worrier, and was personally watching the progress. In order to facilitate rear platform oratory the President's cars were placed at the rear of a train that hardly ranked as express. Between towns the delays grew frequent and a stuffy little aide in uniform protested to the superintendent.

"Look a' here, sir," he said stiffly, "why don't you let these other trains up the line wait?" The division was single-track. "You know this is the President's train."

A twinkle came into the super's eye.

"You 're wrong," he said, in the positive tones of a real executive. "This is *not* the President's special. This is train number 67 of the B—— main line, and she has n't many more rights on the time-card than a gravel limited. Now if you were snitching along on our cracker-*jack* Nippon Limited — there 's some train, sir. They

would n't lay her out. She 's double-extra first-class all the way through to the coast."

The point of that was not lost.

An instance of a different sort occurred some years ago, when Mr. Roosevelt went up into Northern New York to make a speech. The superintendent of the old Black River road was pretty proud of his stretch of line, and invited the then Governor to ride in his neat inspection engine.

" Dee-lighted," said he of the gleaming teeth, and he climbed up into the big cab. The superintendent wondered what he 'd think of that nifty stretch of track just north of Lowville. Col. Roosevelt never thought. As soon as he was settled in the cab he picked a well-thumbed copy of Carlyle's " French Revolution " out of his pocket and read it every inch of the way from Utica to Watertown. The Republican party had to worry along thereafter without that superintendent's vote.

All the superintendents cannot become general managers or railroad presidents; there is not room at the top for even a decent proportion of the best of them. The real tragedy on the division comes when a Prince grows old and for the first time realizes that he is never to be King. When such tragedy shows its head it is time for the stove committee — the men who gossip in roundhouse corners and the yardmaster's office — to talk in whispers.

Buffalo is no mean principality in the railroad world — it is near kingdom in itself — miles and miles and still more miles of congested freight yards, tonnage in breath-taking volume rolling in from the wonderful lakes eight months out of the twelve, a nervous traffic that never ceases. For years there reigned in Buffalo, in calm command of the situation for a great railroad system, a man who was entitled by every virtue of the word to be called superintendent. They called him " the lion " and did not misuse that word either. He was a lion, guardian of a

great railroad gate, a stern old lion whose word and whose law were unquestioned.

But time aged the man, and the day came when the clerks in his outer office began to talk in whispers; they were having the audacity to wonder who the new Prince would be. Two men thought that they were capable — one an assistant superintendent in the great yard at East Buffalo, the other holding similar rank over at Rochester. Each of these men was prepared to assume greater honor, to sit in command at the lion's great desk.

That old fellow sat aloof. His ears were not too deaf to hear the whisperings of his clerks in the outer office, and sometimes when one of them would creep in upon him unawares they would find him sitting alone there, head in hands, holding the fort. The two assistant superintendents gained courage; they went to the picayune business of pulling wires. At other times they locked horns.

They locked horns over one great question. It was not operation that set them at odds, not a vexing practical question of how some congested yard might be lanced so that traffic should flow the more freely, or a main line section be aided to give a greater daily tonnage. Nothing of that sort for the two ambitious assistants.

A new pony inspection engine, with an observation room built forward over the boiler — just the sort that Col. Roosevelt had once used as a reading-room — was to be built for the division, and each assistant thought that he needed that engine for the dignity of his job. Each in turn went before the lion and stated his claims for the possession of the pretty toy. The old man listened with grave dignity. A week later he sent down to the master mechanic at the big Depew shops and had him deliver a brand new hand-car, with his compliments, to each.

The pony-engine went into the roundhouse until the real Prince should come. Then he sat long hours alone at his desk once more.

Finally they brought a man to him, a fine, upstanding

man. The lion rose from his comfy old chair and gave greeting to the newcomer.

"I 'm glad to see you," was all he said; but to the general manager, who had come up from New York, his eyes seemed to ask: "You 've brought the right man here at last?" He turned to the stranger.

"Would you like a pony engine to get over the division?" was his question.

"I 'm willing to go to hell, and go in a caboose," laughed the stranger.

The old superintendent grasped him by the hand.

"Thank God, they 've sent a real man to be superintendent at Buffalo," was all he said. That was the only recognition that he gave to one who since has become one of the master railroaders of America, but in that moment the act of succession had been consummated.

CHAPTER XIV

OPERATING THE RAILROAD

AUTHORITY OF THE CHIEF CLERK AND THAT OF THE ASSISTANT SUPERINTENDENT — RESPONSIBILITIES OF ENGINEERS, FIREMEN, MASTER MECHANIC, TRAIN-MASTER, TRAIN-DESPATCHER — ARRANGING THE TIME-TABLE — FUNDAMENTAL RULES OF OPERATION — SIGNALS — SELECTING ENGINE AND CARS FOR A TRAIN — CLERICAL WORK OF CONDUCTORS — A TRIP WITH THE CONDUCTOR — THE DESPATCHER'S AUTHORITY — SIGNALS ALONG THE LINE — MAINTENANCE OF WAY — SUPERINTENDENT OF BRIDGES AND BUILDINGS — ROAD-MASTER — SECTION BOSS.

THE administration of the division runs quite naturally into several channels. The routine of the work, the making and filing of records and reports, the handling of the mass of correspondence that must constantly arise, is usually in the hands of a chief clerk, who has control over the office force at division headquarters. If there is an assistant superintendent, the chief clerk will divide responsibility with him, the theory at all times being to cut off the detail wherever possible. This office work is not radically different from the office management of any other large business. Its clerks are about the only unorganized force in railroad employ.

If the management of the road is of the divisional type, the superintendent of course is a more important executive than if it is of the departmental type. In either of these cases, as we have seen, he will probably have at least partial authority over the engineer of maintenance of way, whose force keeps the line and track structures in full repair, and also looks after ordinary construction work along the division. In the road of divisional type, he will also have partial authority over the master mechanic, in charge of the shops and roundhouses and the locomotives of the division. These last are regarded by the rail-

road as part of its machinery, like the planers and drills in the shops themselves; and for the care and operation of the locomotives the engineers and firemen are held responsible to the mechanical department. This is the case even upon those railroads where, under the departmental system, the superintendent has no direct authority over the master mechanic upon his division. For the conduct of the trains which their locomotives pull, both engineers and firemen are directly responsible to the operating department. The master mechanic simply sees to it that the railroad's property is maintained to a certain degree of efficiency and that the man who operates the locomotives is capable from every point of view. A reasonable amount of deterioration is expected, and each locomotive is expected to turn in to the shops for inspection, overhauling and repairs, at certain stated intervals.

The superintendent has absolute authority over the two officials who are chiefly interested in the conduct of the trains over the division — the train-master and the train-despatcher. The first of these two officers, who must dovetail their work both night and day, has the assignment of the train crews. His opinion will be called for whenever the vexed questions of seniority and promotion arise, and he will be asked to help to plan all extra or special freight and passenger trains. To show how this is done brings us close to the question of schedules, and we may pause for a moment to consider how this important phase of the railroad's operating is builded together.

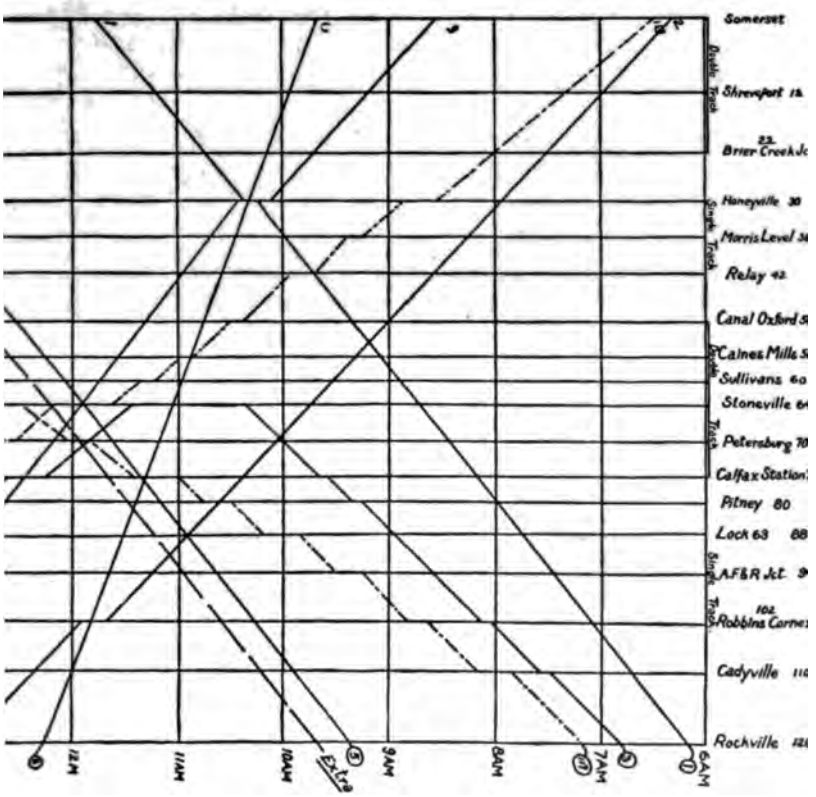
That time-table that you have just pulled from the folder rack seems at first glance an interminable mass of meaningless figures; yet when you come to find your journey upon it, it quickly simplifies itself, and you begin to marvel at the relation the figures bear to one another, how easily you may pick your course through the long columns of numerals. The more extensive time-tables that the railroad employees carry are quite as simple, and yet they are great feats of typographical composition. In

reality, both these forms of printed time-tables are but transcripts of the real time-table of the division, which is kept set out upon a great board.

This board is ruled in two directions. The regularly spaced intervals in one direction are marked as time, and represent time — one entire day of twenty-four hours. In the other direction of the board the stations are spaced in proportion to their actual spacing upon the line.

The reproduction of a portion of such a board for an imaginary division of a railroad will illustrate. This line runs from Somerset to Rockville, 120 miles; and portions of it are double-tracked, the rest single-track, as shown at the top of the diagram. On the double-track, trains going in the same direction may pass one another only at the vertical lines, which represent station passing sidings, and on the single-track sections this rule holds, with the additional one, of course, that trains running in opposite directions may also pass one another at the vertical station lines. For economy of room only the seven hours from six o'clock in the morning until one o'clock in the afternoon are shown here. Following an old-time practice, odd numbers will represent up-bound trains, from Somerset to Rockville; even numbers, the down trains.

So we have an early morning accommodation passenger train, No. 1, leaving Rockville at 6:10 o'clock and proceeding at a leisurely rate of about twenty miles an hour (which makes allowances for local stops) all the way to Somerset at the far end of the division, which it is due to reach at 11:45 A. M. It is halted for any length of time only at Honeytown, where upbound No. 8 — local accommodation — and upbound No. 6 — fast express — will pass it. At 6:20 o'clock an upbound local accommodation of the same nature as No. 1, and hence known as No. 2, leaves Somerset and, halting only at Robbins's Corners to permit the fast upbound No. 6 to overhaul and pass it, reaches Rockville at 1 P. M. Train No. 31, which ollows No. 1 out of Rockville forty minutes later, is a



THE REAL TIME TABLE OF THE DIVISION LOOKS — THE ONE USED IN HEADQUARTERS

milk train, and so must have a liberal allowance for stops. It proceeds only as far as Stoneville, where the dairy country ends, stops there long enough to turn and to water the engine, and then returns to Rockville as No. 32. Train No. 117 is a way-freight, and still slower. So it follows the milk-train. It is known as a " low-class " train by the railroaders. It must wait everywhere for better class trains to pass it. Train No. 118 is the same class of train, proceeding in the opposing direction. Train No. 5 is a down express.

Sometimes unforeseen demands of traffic necessitate the running of extra trains, and these may be strung across the board. This board, in reality, has all its trains placed upon it by strings and pins, to admit of the constant changes that the schedules are always undergoing, and the addition of a new train is a quick proceeding. As a matter of fact, a skilled train-master or despatcher will rarely take the time actually to string an extra train. He carries the schedule too completely in his head to admit of such a necessity.

But the extra train is best placed following, as a second section, some good passenger train, as indicated on the diagram. The regular train will then carry signals showing that it is followed on this particular day. While the train orders protect its movement in any event, as will be shown in a moment, the billing of the extra train as a second section is less of an upset to the regular operation of the division. Practised operating men found years ago that the fewer deviations made from the regular programme of the day, the higher the proportion of safety arose.

Now you begin to see the use of the train-despatcher. If the unforeseen never came to pass upon the railroad, instead of coming to pass nearly every hour, there might be no need of that officer. Each engineer, each conductor, each station agent would have his complete time-tables, and the road would run every day in full accordance with them.

That was the very earliest and the most primitive way of operating railroads. Almost as early the need arose of having a special direction over the operation of the trains. Emergencies arose daily. Trains were often late; storms beat down upon the line; the snow covered its rails; what might have been, according to the time-card, an orderly operation of line, became chaos. If a train was ordered by schedule to meet a train bound in the opposite direction at P——, it might wait there for long hours, not knowing that the other engine was broken down at A——.

The invention of the telegraph and its almost instant application to the railroad service made such special direction possible. So now we find the explicit directions of the schedule supplemented by even more explicit directions from the train-despatcher at the head of the train movements upon each division. Briefly stated, it may be said that the engineer and the conductor in charge of a train are first guided by the schedule, which, after many revisions, has been compiled with great care, and in reference to connecting lines, branches, and adjoining divisions. This schedule acts in conjunction with certain simple fundamental rules of operation, the A, B, C of every railroader. By one of these, trains of the same class bound north or east are given precedence, all other things being equal, over trains bound south or west. This rule is sometimes superseded by one giving right-of-way to trains bound up the line — or the reverse.

High-class trains, like the fastest limited expresses, have precedence over trains of graduated lower classes — down to the slow-moving heavy freights. When any sort of train loses a certain length of time — usually half an hour or more — it loses all rights that it might ever have had, and everything else on the line has precedence over it. A train may lose time if it has to, but there are never any circumstances that will justify it in running ahead of time.

All this is the part of railroad operation which governs the relation of one train to another. There are even

simpler but not less vital rules that control its own operation. In order that the engineer who is guiding the train, and the conductor who shares the responsibility, may keep in touch with one another, the device was adopted many years ago of having a cord run through the cars of passenger trains to a bell signal in the cab of the engine. This bell signal during recent years has given way to an improved form of locomotive signal, sounded by means of compressed air in tubes throughout the train, and operated in connection with the air-brake equipment.

The air-whistle, or bell cord-code of signals, is standard upon all American railroads, and is as follows:

When the train is standing:

Two signals — start.
Three signals — back.
Four signals — apply or release air-brakes.
Five signals — call in flagman.

When the train is in motion:

Two signals — stop at once.
Three signals — stop at the next station.
Four signals — reduce speed.
Five signals — increase speed.

There also arises a necessity for communication between men who stand outside the train and who seek to guide the movement of the locomotive. This necessity has given rise to still another code, transmitted by the hands — holding a flag, if possible — by day, and a lighted lantern at night. This signal code follows:

Method of Transmitting Signal.	Indication.
Swung across track.	Stop.
Raised and lowered vertically.	Proceed.
Swung vertically in a circle across the track:	
When the train is standing —	Back.
When train is in motion —	Train has parted.

Swung horizontally in a circle:
When the train is standing — Apply air-brakes.
Held at arm's length above head:
When the train is standing — Release air-brakes.
Any object waved violently by any person on or near the track is a stop signal.

By use of his locomotive whistle, the engineer is enabled to acknowledge these signals, as well as to signal upon his own initiative. His code is also a standard in railroading. It follows:

— A short blast.	——— A long blast.
—	Stop, apply brakes.
——— ———	Release brakes.
— — ——— ——— ———	Flagman go back
— ——— ——— ———	and protect rear end of train.
——— ——— ——— ———	Flagman return to train.
——— ——— ———	Train in motion, has parted.
— —	Acknowledgment of signals, not otherwise provided for.
— — —	Standing train — back.
— — — —	Call for signals.
——— — —	Calls attention to following section.
——— ——— — —	Highway crossing signal.
———	Approaching stations, junctions or railroad crossings at grade.

A succession of short blasts is an alarm for persons on the track and calls the attention of trainmen to danger *ahead.*

These signal codes operate fundamentally in connection with the essential rules of schedule that we have already shown.

Suppose now that we consider the workings of all this system as it comes down to actual practice in a single concrete instance. We are finding our way to a big terminal yard in all the murkiness and cloudiness of very early morning, and once again we hunt out that urbane soul, the yardmaster. He holds in his hand the yellow tissue of an order from the despatcher of the division. In the conciseness of telegraphy it tells him to start a third section of train 118 — through freight — at 6:15 o'clock. Just back of his little grimy box of an office is the big sprawling roundhouse — a dozen freighters with banked fires standing in the stalls, awaiting summons to work. The twelve engines are divided into several classifications according to pulling strength and speed, but the despatcher has designated the particular engine he wishes for third-118, and he gets it — a big lanky puller — 1847. She is chosen chiefly because she has had the longest roundhouse rest, having brought in a through freight from up the line, and having been received with engineer's report showing her to be in good running order, at five o'clock yesterday afternoon. Before the 1847 slipped from the turntable into the waiting stall, the hostlers and the wipers were at her. The hostlers had taken her over the cinder-pit and cleaned out the fire-box. Then they went over her, cleaning her, inch by inch, a mechanical inspector in their wake, testing and sounding and checking every item in the engineer's report which showed 1847 to be in good order at the end of his run with her. There was not much chance left for any shirking of responsibility, no matter what might arise upon the 1847 on any coming day.

We turn and watch the yardmaster once again. He has the roundhouse foreman send one of the bright young boys who hang around his office night and day, and who dream of that coming hour when they will handle an 1847

for themselves, to call the engineer and fireman, whose names are posted "first out." Or perhaps the telephone has come into play — in these days in the smaller towns there is hardly a house too humble to have receiver and transmitter hanging somewhere upon its walls. In any event the engine-crew are supposed to stay home when off duty, unless especially excused, and to live within reasonable distance — say a mile — of the roundhouse.

The caller tells the engineer and fireman to report at the roundhouse at 5:45 a. m. At that hour the hostlers have made the 1847 fit for service. Her tender has been filled with coal, her tanks with water, even her sand is packed aboard the box that stands upon the boiler and is ready to help on slippery rail and upgrade. The engineer makes keen inspection of the 1847 before he moves her a single inch, makes sure with his keen and practised eye that she is quite fit for service, pokes here and there and everywhere with his long-spouted oil-can. At a minute or two after shop whistles have shrieked "six o'clock" he pulls the 1847 out from the shadows of the roundhouse. He gets an open signal and switch to the main yard and finds waiting on a siding in that great place, the trail of freight cars and the caboose that are going with him to make Third-118.

Now come back for a moment in your thought. While we were still scurrying down to the grimy yard, the despatcher was creating Third-118. On his desk were car reports, showing what had been received and sent out, and there was enough accumulation of stuff in the yards last night to justify a Third-118. Because good railroading means yard-sidings cleared, and standing cars and freight, like passengers, kept constantly moving, he did not hesitate at ordering her out. He found that there would be 32 cars between tender and caboose, weighing approximately some 1200 tons, and so he ordered from the roundhouse an engine of a class which the mechanical depart-

...esy of the "Railroad Age Gazette

...E ELECTRO-PNEUMATIC SIGNAL-BOX IN THE CONTROL TOWER OF A MODERN TERMINAL

...E RESPONSIBLE MEN WHO STAND AT THE SWITCH-TOWER OF A ...DERN TERMINAL: A LARGE TOWER OF THE "MANUAL" TYPE

"When winter comes upon the lines the superintendent will have full use for every one of his wits"

Watchful signals guarding the main line of a busy railroad

ment guaranteed capable of pulling from 1,000 to 1,500 tons, gross weight.

The yardmaster had given the numbers of the cars that were to make Third-118, just as he received them from one of the despatcher's assistants, to a switching foreman, who arranged them, with the quick facility that comes from long practice, into an order that would permit them to be set off at various points up the line, with the least possible amount of switching. That practical sequence worked out in pencil and paper, a stubby switch-engine effected in reality. The cars and the caboose, in proper order, were ready, with the crew, and inspected when the 1847 backed to them and Third-118 came into her being.

A yard caller had summoned the train-crew while the roundhouse caller was rounding up the two men of the engine-crew. Collins, the conductor, and his brakemen had reported at the yard-office, and were assigned to Third-118. Collins found the cars and caboose waiting just a few minutes before the 1847 had been coupled to them, with little ado and no formality whatsoever, beyond the testing of the air-brakes. Into his train-book he had entered the number of each car and the initials of the road owning it, its destination, its empty or tare weight; the weight of its load, and the sum of these or its gross weight. He sees to it that each box-car is firmly seal-locked. If not, he refuses to accept it from the yardmaster until it has been resealed, and makes a note of the occurrence. Like the engineer and the hostlers in the roundhouse, he takes no chances, no responsibilities that do not fairly belong to him.

With both conductor and engineer ready, Third-118 starts upon her day's run. The yard operator has telegraphed the despatcher's office that 3-118 is awaiting instructions. In that despatch he has given the locomotive number, the number and total weight of the cars it hauls, the name of both engineer and conductor. The train-

despatcher enters these details of train and crew at head of a column of his train register. On that regi there are spaces for the entries of arriving and lea times of the train as telegraphed him by the operator each telegraph station on the division.

The train once so entered by a despatcher's clerk, despatcher sends a clearance card to the telegraph o ator at the little yard office who repeats it back for a racy. Then the yard operator presents that clear order to the engineer and conductor, who read it alou him — also for accuracy, of course — and then sign they have read and understood the order. The signat are then reported to the despatcher's office, which w "Complete." "Complete" goes in writing upon copies of the order made in manifold, which go to engir to conductor, and to the operator's own files. The gineer reads his order to the fireman, who repeats it l to him; the conductor follows the same routine with brakemen. That all sounds complicated, but quickly comes mechanical and rapid; the danger is that it may come so mechanical and rapid as to permit of ser errors passing unchecked through the routine. But railroad has done its part. It has, for itself, taken e possible precaution against error and resulting accid

We are privileged, and we climb into the caboos Third-118. We hold credentials to Collins, her con tor, and they are unimpeachable. We can see that f his face as he holds his lantern over them: he would even let us into his caboose until his own mind was After that there was barely time to jump aboard. 1847 is beginning to clear the yard before we have time for a good look at the inside of the little caboos

"You won't find our hack any fancy place," says lins. "But we 've had it nine years now, and it se kind of homelike to us after all this time."

The "we" consists of Collins and his rear braken *The* forward brakeman, who is held responsible for

front half of the train, has his headquarters in the cab of the 1847. The caboose is a home-like place, snugly warmed by a red-hot stove placed in its corner and lined with bunks made into beds, Pullman fashion; only never was there a Pullman sleeper that gave you less sense of the impressive and a greater sense of a snug cabin. Squarely placed in its centre is a sort of wooden pyramid and the steps up this lead to the lookout from where the long snaky train can be watched.

"Kind o' ol'-fashioned, that," apologizes Collins. "Th' las' time I had th' cabin into the shops for overhaulin', they offered to take it out an' put in th' ladders; but I says 'no'; an' this is why."

One by one he lifts its hinged steps. This is a pyramid built of lockers, a regular treasure house of railroad necessities. There are all sorts of ropes and jacks and wrenches, extra parts against every emergency. There is a food closet, and another locker filled with neat stacks of stationery.

"They give us more forms to fill out now than th' super's office got twenty years ago," he laughs. "I spend more than half my time at that desk."

The clerical work on Third-118 is considerable. Collins has to keep all the way-bills of his train — 32 cars, almost $100,000 worth of merchandise, and if he makes a serious error it is apt to cost him his job. He writes a neat hand, and his records, like his caboose, are kept in ship-shape fashion. He is a careful student of the ethics and the practices of railroad management and operation. He has his own ideas on each of these, and when you get to them they are good ideas. Of such as he railroad executives are every year made in America.

We slip up the line, slowly threading our passage through the mass of passenger trains, fast and slow, that all times have the right-of-way over the third sections of rather ordinary freights. Collins sometimes thrusts his

orders into our hands in order that we may see something of the great detail of this branch of operating. Each is wonderfully specific, and we know by that "complete" on the corner that it has been given in detail.

"No. I Engine 2236 will wait at Morris Level until 10:00 A. M. for 3-118, Engine 1847."

The signature is that of the initials of the division superintendent, the numerals have been spelled out. It would seem as if the railroad had taken every possible precaution for safety. And yet again, remember that great accidents have happened upon American railroads just because men's minds have perversely refused to read what eyes and ears have read. And yet there seems to be nothing to be done, more thorough than is already being done.

"Are all these freights upon schedule?" you may ask Collins, after you meet a few dozen of them within the limits of a single-track division. He is decent enough not to laugh at your ignorance.

"Schedule?" he repeats. "It 's a joke. They give our first section a time to get out on, in the time-card and then one o' them bright office-boys gets a figger out o' his head an' puts it down for an arrivin' time. He never hits it an' he never expects to. So more an' more they 're gettin' to move this freight on special orders. They can better regulate it then, 'cordin' to volume of business. Mos' of the men carry the schedules of the fas' an' th' way-freights in their domes. Th' coarse tonnage stuff does n't even get special orders. When they get enough of it, down on th' main line, they get an engine out o' th' roundhouse, give the train th' engine number, and start off. Railroad traffic along the freight end follows business conditions mighty close."

It is still daylight when we halt at a junction, across a frozen river from a city. The city is set upon a steep hillside, and its houses rise from the river in even ter- ces. At the top a great domed structure — the State se — crowns it. It is a still winter's morning, and the

smoke from all the chimney-pots extends straight heavenward. We wait patiently upon a long siding until everything else has been moved — through fast expresses heavily laden with opulent-looking Pullmans, jerky little suburban trains, long draughts of empty coaches, being drawn by consequential switch-engines in and out of the train-shed of the passenger station. Finally a certain semaphore blade drops, we cross over to the important main line and begin pulling on a sharp curve, across the river, clear of the station with its confusion, through and past the city to a busy division yard.

In a very little time, for this is their home town, Collins and his crew are registering at the yardmaster's office. The engineer of the 1847, and his fireman, turn in their time-slips and proceed with the locomotive to the roundhouse where they make a report upon its condition. Their names are posted on the "in" list or register, and they are off duty until they are summoned by the callers at this end of the division. The despatcher has, of course, been apprised of the safe ending of the run of Third-118.

In the despatcher we have a high type of railroad official who works almost unknown to the great travelling public, and yet accepts a very great measure of the responsibility for the safe operation of the lines. His orders, sent by telegraph and bearing that cabalistic initial signature of his superintendent, are the products of his own mind. There can be no mistake in these, and he knows it. Each message that he sends may produce disaster, and he knows that.

He is an executive of a type that is not to be passed by lightly. He has risen from the ranks of the telegraphers, most likely from some lonely country station or forlorn signal-tower, and his knowledge of railroad operation, both theoretical and practical, must approach perfection. On sunny, serene days he proceeds with the theoretical railroading; when storms or unexpected influxes of traffic come

to harass the division, he will need every bit of his p
tical knowledge. Handling a number of special tr
— freight or passenger — is a strain, and that stra
most felt at the despatcher's desk.

Now and then your morning paper tells of a rail
wreck, and laconically adds, "The despatcher wa
fault." The stories of the wrecks that were forest
by the sheer genius of the men who sit night and d
the telegraph instruments at headquarters are the st
that are for the most part untold, and that far surpa
thrill and interest the stories of the failures.

The despatcher must also be the full measure of a
He is, like the silent figure upon the bridge of a great
of unquestioned authority as he sits at his desk. He
or may not have a map of the line before him as h
there, but you may be certain that he knows where
moving train on the division is at the moment yo
him, just as clearly as if it were all visible there t
naked eye in some sort of picture map. No trains
ceed without his express orders. He has "reliefs"
there is no hour of day or night when one of these i
at the despatcher's desk, having the work of the line u
his exact supervision.

The order that any train receives from the despa
by means of the telegraph will, as we saw in Col
case, direct it to proceed to a certain point on the line
will specify every train, regular or extra, that it will
and the meeting point. When the train has proceed
the end of its orders there will be more orders fron
train-despatcher to be receipted for, and so it will pr
to the end of the route. It is quite possible that a
stage of the journey orders will come from headqua
nullifying those already issued, in part or entirely;
these must be accounted for in the same thorough an
curate fashion. Some of this seems "red tape" t
men on the line, and there come times when they are
disposed to rebel at what seems to them useless forma

There also come times when trains crash into one another; and at those times the railroad, with its infinite system of recording its orders, is generally apt to be able to place the blame pretty accurately. Those are the times when the system of train orders justifies its worth.

Recently the telephone has come into something more than an experimental use in despatching trains upon American railroads. Various causes have contributed to this. For one thing, the use of the telephone enables the average road to make good use of its veterans, men who would indignantly refuse to become pensioners, and yet who have come to a time in their lives when they must set their pace in gentler key. A trusted old employee, a man crippled perhaps in loyalty to the company's service, a keen-witted responsible woman, any one of these can competently handle train orders over a telephone, without having to have the education and the wonderful expertness that comes only from long experience in telegraphy; and they all become available in the despatching service. Still another cause has contributed to the change, which is being reported each week from some fresh corner of the country — the telegraphers, themselves. Within the past few years they were able to induce Congress to reduce their day's work to eight hours. Translated, this meant that the average way-station which had been manned by one or two operators would correspondingly need two or three operators. The telegraphers, by reason of the expert training needed in their business, kept their wage-scale up, and the railroads felt that eight-hour bill keenly in their treasuries. So there may have been the least bit of retribution in their seeking the telephone as a relief. The change has certainly been made in the keen hope of effecting economy. No railroad operator would feel ashamed to admit that fine impeachment.

Modern railroading simply makes the same demand of the telephone that it makes of the telegraph — that it keep the probability of safety high. It makes the same de-

mand of the men who maintain the signals, the track, t[illegible] bridges, and other portions of the right-of-way. Let consider them in the passing of an instant.

You know the signals along the line of the railroad — those gaunt, uncanny things that spell danger or safety to the men in the engine-cabs. A little while ago, we stood beside a man in the sun-filled tower of a great railroad terminal and watched him operate the most complicated switch and signal system in the land, watched him with the crooking of a finger upon the lever of an electric machine raise this blade, lower that, as he made new paths for the many trains, coming and going.

A plant of that sort is known as the interlocking. In its simplest form, it will guard a junction between two single tracks. The mast of the signal will rise, according to standard custom, at the right of the track in the direction of travel, and there will probably be two semaphore blades, the upper of which guards and signals the straight main-line or "superior" track, the lower, the diverging branch, known as the "inferior" track. The blade raised — automatically showing a red light — indicates that the main line is closed to the engineer. "Stop!" "Danger!" are the words it tells him. The blade lowered, a green light is automatically displayed, and the engineer knows that he can go ahead at full speed on the main line. The road is clear for him. The lower blade gives similar indications for the branch diverging line. Normally, both blades stand at "stop" and "danger," and the one guarding the line for which the train is destined, is dropped only on the approach of the train, itself. In fact, to facilitate the movement of trains, these guarding signals — known to the signal experts as "home signals" — are generally interlocked with "distant signals" several hundred feet down the line, on which blades indicating the diverging tracks forecast the story that the "home signal" is to tell the engineer. The blade raised — by night displaying a white or safety signal — on the "distant signal" indi-

cates that the line it guards is blocked at the "home signal," and that the engineer must be prepared to bring his train to a full stop. Dropped — showing the green safety light — that particular line is open and ready, and the engineer can be prepared to pass the junction without a very great diminution of speed.

That is the fundamental rule of the signal. Some roads have experimented with other forms of indicators — disks of one sort or another, semaphore blades that turn upwards rather than drop. The devices are numerous, but the principle is the same. When the tracks begin to multiply, and the signals begin to multiply in even greater proportion, they are generally carried over the tracks on a light bridge construction — our English cousins call it a "gantry" — and a series of small semaphore masts built up from the bridge. One of these masts, or "dolls," will be assigned to each track; and if there chances to be an unsignalled siding-track of little importance passing under the bridge, it will have its own "doll" rising from the bridge although quite devoid of semaphore blades. So it is all quite as clear as print to the engineer, even when forty or fifty lights blink at him from a single bridge. The signals tell their story to him quite as simply as to the man in the tower, who is setting their blades in accordance with his carefully arranged plans.

Where signals are not of this interlocking type, guarding some junction, railroad grade crossing, draw-bridge or other point of possible danger, they are likely to resolve themselves into the block system. This system, in a rather crude form, with the use of operators at each block-tower or way-station, has been in development for something less than thirty years upon the American railroad. In brief, it divides a line — usually double-tracked, but sometimes used by the so-called "staff" method upon a single-track road — into sections, or blocks, of from three to five miles each. On double-track under this system, no two trains, even though travelling in the same direction are permitted

in the same block. At the entrance to each block stands a tall mast with two of the conventional signal blades. The upper of these raised denotes that a train is still in the block, and an engineer must stop his train and wait till it drops, before he can proceed. The lower blade, when raised, indicates that a train is in the second block ahead, and the engineer must proceed only with caution and expecting to find that block closed against him. It is all quite simple; and if the engineers followed the signals absolutely, there never could be any rear-end collisions on lines protected by block signals. As a matter of fact, there rarely ever are, although the engineers do take chances time and time again.

"Why should I stop for that thing," said a veteran engineer on a fast express train as we went whirring by one of those upper blades raised and commanding us in a blood-red point of light to stop, "when I can look down this straight stretch and see they 're clear? Like as not something 's got into the mechanism of it and let her flop that way."

Do not insult the intelligence of that engineer. A little while before, he had told us, with a deal of pride, that the rolling stock of "his road" placed end to end would reach from New York to Omaha, a distance of some 1300 miles. Keenest of the keen, he had a sort of contempt for a rule-book in such a case as that.

"Is n't it sort of positive?" we began. "Good excuse anyway —"

"It is," he shouted back, "but somehow it don't go if you fall behind on your running time. We 're here to use ordinary good sense — and bring our trains in on time."

And yet the railroad has a sharp way of insisting upon compliance with that book of rules by making, once in a great while, surprise tests. A signal is set at danger, without any more apparent reason than in the case just cited; a secret watch is kept, and judgment and discipline

e visited upon the heads of the engineers who permit emselves to run past it.

To operate the signals calls for one body of men, and to aintain them for faithful service against all manner and ress of wear and weather, another; just as there must be working corps to keep the right-of-way in working order. his last is a mighty brigade of the railroad's army; for ne man in every four who works for it is employed in eeping the track in order. One dollar in every six that ie railroad spends goes for that purpose.

Maintenance of way on each division divides itself into superintendent of bridges and buildings, who sees to the ipkeep of those facilities; and a roadmaster, who specializes upon the track itself. This last officer, almost invariably one who has begun to shoulder himself up in the ranks of the railroad army from the very beginning, has his territory divided into sections from two to five miles in length on double-track, from four to ten on single. In command of each section a faithful hand-car and a group of more or less faithful section-hands, figured on an allowance of one to each mile of track, is a section-boss. The section-boss is a wry and a wise soul, or should be. He may not know as much about the formulas for compensating curves as that bright boy who has just come out of a "tech" school to stand his turn at a transit, but he has a marvellous sort of intuitive sense in keeping his little stretch of track in order. He can sight his rail and discover flaws in alignment as a blind man can find surface flaws with the developed tips of his fingers, and all the while he may be growling at the railroad management for adding to the weight of its rolling-stock and "pounding the elevations out of his track."

In summer he is expert with the "track jacks" and constantly putting in bits of ballast here and there; and in the winter, when the frost and snow have made it impos-

promised well at the outset have been found faulty after trial, and rejected. Committees of trained experts have pondered and reported voluminously; the standard railroad codes of every sort have been born because of them. The operation of the railroad has been brought close to science. It would seem as if the entire field had been completely covered.

And yet new situations constantly arise, the like of which have never before presented themselves, even to the railroad veterans. Traffic moves in unequal volume, particularly freight traffic. There are single-track stretches through the Middle West that starve through eleven months of the year, and for the other thirty days handle in grain more tonnage than a double-track trunk-line in the East. Obviously such lines cannot be double-tracked for thirty days of business; quite as obviously the overtaxed division, its equipment, and its men must rise to every necessity of the floodtide of business. There are fat years and there are lean years. There come years of bumper crops, years when the factory lights burn from sunset to dawn, and wheels turn unceasingly, and then the superintendent wonders how his equipment and men are going to stand the strain. Engines are kept from the shops and in service; nothing that is even a semblance of a car is kept out of service; the demand for men is keen; prosperity strains the resources of the railroad.

In the lean years, engines are sometimes kept from the shops because the railroad feels that it must hold down its running expenses to keep pace with reduced revenues, and such a course it can stoutly defend as nothing else than good business. Equipment begins to stand idle. Engines are tucked away on empty sidings, boarded and forlorn; and if the year be very lean indeed, the superintendent may find it necessary to send out a wrecking crane and begin lifting empty cars off the rails and leaving them in the ditch at the side of the right-of-way, until the golden times come again. At such seasons his ingenuity is tested quite

as much as in the times of floodtide. Orders come to cut expenses, and his big expense is the pay-roll. When he begins to blue-pencil that pay-roll, some one is going to be hungry. The superintendent knows that. He must move with great care in such emergencies.

CHAPTER XV

THE FELLOWS OUT UPON THE LINE

MEN WHO RUN THE TRAINS MUST HAVE BRAIN AS WELL AS MUSCLE — THEIR TRAINING — FROM FARMER'S BOY TO ENGINEER — THE BRAKEMAN'S DANGEROUS WORK — BAGGAGEMAN AND MAIL CLERKS — HAND-SWITCHMEN — THE MULTIFARIOUS DUTIES OF COUNTRY STATION-AGENTS.

ONE man in every twelve in the United States is on the pay-roll of a railroad. No wonder that that great organism comes so close to human life throughout the nation, that we seem to touch it at every turn.

This one out of twelve is the great army of industrial America. Composed of nearly 1,500,000 men, it is an army that inspires loyalty and coöperation within its own ranks, and confidence and admiration from without. To a nation whose creed is work, it stands as the uniformed host stands to a fighting nation like England or France or Germany. The army of industrial America inspires not one whit less affection than those great crops of paid fighters in Europe.

Ninety-six per cent of this army of railroaders are engaged in the business of maintaining and operating the great avenues of transportation, an overwhelming proportion in the last phase of the business. The operating department is, to the average mind, the railroad. Its members are the men with whom the public come oftenest in contact; they are the men who are oftenest called upon to hazard life and limb in the pursuit of their callings. The romance of the railroad — a romance that is told in unending prose and verse — hovers over the men who operate it. The men who labor in the shops and keep engines and cars safe and fit for the most efficient service

have no small responsibilities. Moreover, their work, forging and finishing great masses of metal, is not without its own hazards. The men who give their time and talents to the maintenance of the track and the structure of the railroad have equal responsibilities. It is not doubted for an instant that both of these are important functions in the conduct of railroad transportation, and each in turn will have full attention given to it.

In a previous chapter we have considered the men who control the actual operation of the railroad, the safe conduct of its trains up and down the line. How about the privates in the ranks of this industrial army, the men, who by their loyalty and ability form the very foundations of successful operation, who also form the material from which executives are chosen every day?

There are no common laborers in this phase of railroad work. A man with stout muscles and less than the average amount of brains can ofttimes shovel ballast out with the track-gangs; there are many, many opportunities for crude labor in the heavy metal work of the railroad's shops; there are none within the scientific activity that gives itself to the running of the trains. The humblest of these folk must have a particular talent, a talent so peculiar that it might almost be described as "latent Americanism." The lowest-priced man in the train-service must understand the entire complicated theories of railroad operation to a T. He may be the man on whom responsibility — the responsibility for the safety of not one but many human lives — may suddenly be thrust. A gate-tender at a highway crossing has not ordinarily a place of gravest responsibility; yet in some least expected hour this humblest employee of the operating department may hold the fate of human life in the balancing of his steady hands.

Americans run the American railroads. For this great service men must possess not only the mental capacity for understanding the technique of operation, but the physical strength to meet the stress of hard labor, and of every

rt of weather, and of long hours spent upon moving ains. Moreover, there is a requirement of morals — at a man must fully know and quite as fully accept the sponsibility for human life that is placed in his hands. hese things combined make that " latent Americanism " f which we have just spoken; and the railroad that digs eep into this mine of " latent Americanism " finds its ma- erial, not in the great cities with their vast colonies of oreigners, but on the farms of a broad, broad land. The oy standing in the pasture sees the express train go skim- ming past him from an unknown great world into another unknown great world, and straightway he has the railroad fever. He drives to the depot with the milk cans, and there he comes in contact with the personnel of that link of steel that stretches across the farm where he was born. It is only a little time after that before he is applying for work as a railroad man.

So it is that the railroad finds fine timber for its service. It picks and chooses. For its choice it has the pick of American timber, the ironwood of our national forests of humanity. It gathers its army of men, inspects them carefully for physical, mental and moral requirements and then it impresses upon them the necessity of good living, the absolute necessity of deference to an established and rigid system of discipline as a requirement in the successful handling of the different transportation business.

Thus we have the railroad men as the best workers of the nation. If you want proof of that, ask any of the great mail-order concerns which class of business they prefer and they will tell you without hesitation that it is the railroad man. Come closer home and ask the merchants of any community the same question. Their answer will be the same. Rigid conditions, out-of-door life, sober habits make desirable citizens out of this class of workers. There are none better anywhere.

In the train service, the ordinary route of promotion is through the freight service to the passenger. Thus, for

the farmer's boy who hankers to sit in the cab of the locomotive that hauls the Limited there is a long hard path. Chances are that at the beginning the road foreman of engines will start him at odd chores, calling crews, wiping engines, and the like, around some one of the big roundhouses. He will work hard, but here he will begin to absorb the romance of the line, the romance that, like fog and engine smoke, lies around the engine house, thick enough to cut. Perhaps after a while they will give him a little authority and make him a hostler. The "hostler" and the "stalls" in the roundhouses are quaint survivals of the most primitive railroad days, when horses were really motive power.

At odd times, night times perhaps, the boy will ride in engine cabs and gradually acquire a knowledge of one of these great machines such as no text-book would ever give him. Then comes his first big opportunity. There is a vacancy among the engine crews; the road foreman of engines gives him a good report, and he begins to have dealing with the train-master. He is made a fireman, and he travels the division end to end, day in and day out.

Now he knows why the railroad requires physical tests as well as tests of eyesight and of hearing. Even after he has taken another step in advance and been promoted to the passenger service (we will assume that ours is a bright, ambitious boy), he will only find that his labors in the engine-cab have been increased. It is no slight task, firing a heavy locomotive over 100 or more miles of grade-climbing, curve-rounding railroad. It is a task that fairly calls for human arms of steel; for some firemen handle some 17 tons of coal in a single run. The appetite of that firebox is seemingly insatiable. There is hardly a moment during the run that it is not clamoring to be fed, and that the fireman is not hard at it there on the rocking floor of the swaying tender, reaching from tender coal to firebox door.

But the day does come, if he sticks hard at it, when he

becomes an engineer. He has learned the line well, during his countless trips over it as fireman. He has come to know every signal, every bridge, every station, every curve, every grade, every place for slow, careful running, every place for speeding, as thoroughly as ever river pilot learned his course. There have been many times when he has had to assume temporary charge of the engine. He is a qualified man at least to sit in the right hand of the cab, to have command over reverse lever and over throttle.

His work is of a different sort already. The hard physical labor is a thing of the past, most of the time he sits at his work. But responsibility replaces physical stress, and the farmer boy now realizes which of the two is more wearing. Upon his judgment — instant judgment time and time and time again — the fate of that heavy train depends. After he has been promoted from freight engineer to passenger engineer he has a train filled with humanity, and he knows the difference. By day the inclination of a single blade, by night the friendly welcome or the harsh command of changeable lights must never escape him. One slip, and after that —

The engineer prefers not to think of that. He prefers to think of a safe trip, terminal to terminal, to think of the long line covered, once again in safety, to think of the station at the far end of the division, where a relief engine and engineer will be in waiting to take the train another stage in its long journey across the land, to think of the home and family awaiting him. He is a big passenger man now. When he gets to the end of the run, there will be a crew to take his locomotive away to the roundhouse. He will have a bit of a wash and in a few minutes he will be bound through the station waiting-room, well dressed, smoking a good fifteen-cent cigar, quite as fine a type of American citizen as you might wish to see anywhere. You would hardly recognize in this well-dressed man of affairs, the keen-eyed, sound-bodied man in

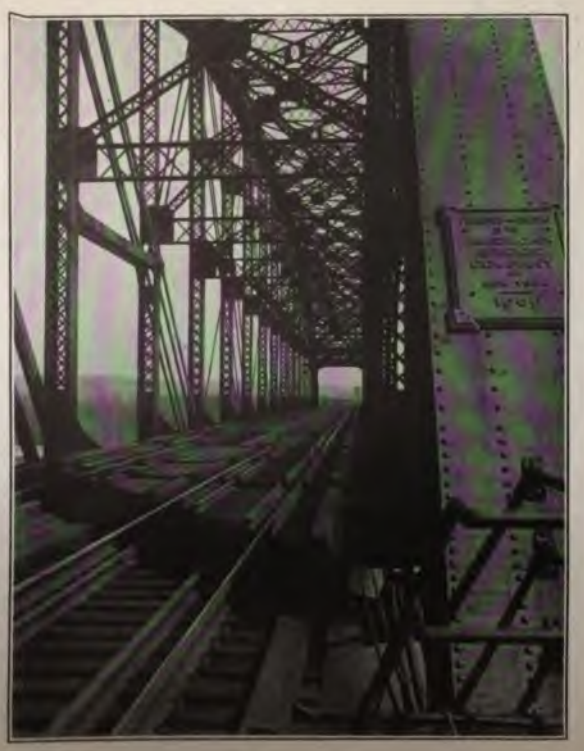
blue jeans who stood beside his engine, oil-can in hand, at the far end of the division.

The same type holds true through the man in care of the other parts of the trains. Take the brakeman — they call him trainman nowadays in the passenger service. In the old days this was a slouchy, somewhat slovenly dressed individual of a self-acknowledged independence. Time has changed him in thirty years. An increased respect for the service has taken away from him his slouchiness; a feeling that good work and hard work will take him through the ranks, through a service as conductor, perhaps to train-master, to superintendent, goodness knows how much further, has replaced that bumptious independence.

He began as brakeman on a freight. There were two, possibly three, of these men to the train, under command of the conductor, back there in the caboose, and they were supposed to distribute themselves pretty equally over the top of the train. The forward brakeman would work from the cab backward, the rear brakeman from the caboose (he also probably calls it a "hack"), forward, the remaining man when a third was assigned to the train, having the middle. It was thought and confidently predicted that with the universal use of the air-brake to freight equipment the days of clambering over the tops of the cars to man the brakes were over. Brakemen twenty years ago were dreaming of the day when they might sit in a cab or caboose and have the difficult work of slacking or the stopping of a 1,500-ton train accomplished, through the genius of mechanism, by a hand-turn of the engineer upon an air-brake throttle. But what looked so well in theory has not worked quite so well in practice. The railroads have found the wear and tear on the air-brake equipment, particularly with the steep grade lines and heavy equipment, a tremendous expense. For the sake of that and for the sake of still greater safety — following *the* railroad rule to use each possible safety measure, one

HE TRAIN COMES TO A WATER STATION THE FIREMAN GETS OUT AND FILLS THE TANK "

A FREIGHT-CREW AND ITS " HACK "



upon the other — the brakemen are still compelled to keep to the top of the cars.

On a pleasant day this is a task that can give the average brakeman a sort of supreme contempt for the man whose work houses him within four walls. If the road lies through a lovely country, if it pierces mountain ranges, or follows the twisting course of a broad river, he may feel a contempt, too, for the passenger who observes the lovely scenes only through the narrow confines of a car window. To him there is a broad horizon, and he would be a poor sort of man indeed if he did not rise to the inspiration of this environment.

There is quite another side of this in the winter. Let wind and rain and then freezing weather come, and that icy footpath over the top of the snaky train becomes the most dangerous way in all Christendom. It consists of only three narrow planks laid lengthwise of the train, and between the cars there is a two-foot interval to be jumped. Hand-rails of any sort are an impossibility, and the brakeman now and then will receive a sharp slap in the face that is not the slap of wind or of sleet, and he will fall flat upon the car-roof or dodge to the ladders that run up between the cars. That slap was the slap of the "tickler," that gallows-like affair that stands guard before tunnels and low bridges and gives crude warning to the man working upon the train roofs of a worse slap yet to come.

There are other dangers, not the least of these the possibility of open battle at any time of day or night with one or more "hobos," tramps, or "yeggmen," who seem to regard freight trains as complimentary transportation extended to them as a right, and train-crews as their natural enemies. The list of railroad men who have lost their lives because of these thugs is not a short one. It is one of the many records of railroad heroism.

Still the brakeman has a far easier time of it than his prototype of a generation or more back. The air-brake is a big help. When a train breaks in two or three parts

on a grade, the pulling out of the air-couplings automatically sets the brakes on every part, and if you do not know what that means ask one of the old-timers. In the old days of the hand-brakes the very worst of all freight accidents came when a section of a freight train without any one aboard to set its brakes, broke loose and came crashing down a hill into some helpless train. Ask the old-timer about the hand-couplings and the terrific record of maimed arms and bodies that they left. The modern automatic couplings have been worth far more than their cost to the railroads.

In the course of time and advancement the brakeman leaves the freight and enters the passenger service. Now he is called a trainman and is attired in a natty uniform. He has to shave, to keep his hands clean, wear gloves perhaps, and be a little more of a Chesterfield. He must announce the stations in fairly intelligible tones, and be prepared to answer pleasantly and accurately the thousand and one foolish questions put to him by passengers.

As a conductor he will probably begin as Collins began, in the freight service. When he comes to the passenger-service there will be still more book-keeping to confront him, and he will have to be a man of good mental attainments to handle all the many, many varieties of local and through tickets, mileage-books, passes, and other forms of transportation contracts that come to him, to detect the good from the bad, to throw out the counterfeits that are constantly being offered to him. He will have to carry quite a money account for cash affairs, and he knows that mistakes will have to be paid out of his own pocket.

All this is only a phase of his business. He is responsible for the care and safe conduct of his train, equally responsible in this last respect with the engineer. He also receives and signs for the train orders, and he is required to keep in mind every detail of the train's progress over the line. He will have his own assortment of questions to answer at every stage of the journey, and

will be expected to maintain the discipline of the rail-
ad upon its trains. That may mean in one instance
e ejectment of a passenger who refuses to pay his fare,
d still he must not involve the road in any big damage
it; or in another, the subjugation of some gang of
unken loafers. The real wonder of it is that so many
nductors come as near as they do to the Chesterfieldian
ındards.

In the forward part of the train are still other members
its crew, some of them possibly who are not paid by
: railroad, but who are indirectly of its service. Among
:se last may be classed the mail clerks, who are dis-
ctly employees of the Federal Government, and the
:ssengers of the various express companies. If the road
small and the train unimportant, these workers may be
ɔuped with the baggagemen in the baggage-car. If the
in is still less important the baggageman may assume
rt of the functions of mail clerk and express messenger.
so, he is apt to have his own hands full. The mere
ınual exercise of stacking a 60-foot baggage-car from
or to ceiling with heavy trunks (and the commercial
.vellers and theatrical folk *do* carry heavy trunks) is
slight matter. But that is not all. The trunk put off
the wrong place or the trunk that is not put off at all
apt to make the railroad an enemy for life and the
ggageman is another one of the many in the service
ıo are permitted to make no mistakes.
When he has United States mail-sacks and a stack of
ɔress packages to handle, his troubles only multiply.
s book-keeping increases prodigiously, and his temper
dergoes a sharper strain. Give him all these, then a
ıple of fighting Boston terriers, which must, because of
e of the many minor regulations of railroad passenger
.ffic, ride in the baggage-car — a cold and draughty
· — and you will no longer wonder why the baggage-
ın has a streak of ill-temper at times. His office is

certainly no sinecure, neither is he in the direct path of advancement like his co-workers, the fireman and the brakeman.

These train-workers who are so little seen by the travelling public — baggagemen, mail clerks and express messengers alike, ride in the most hazardous part of the equipment, the extreme forward cars of the train. Read the list of train accidents, involving loss of life, and in nine cases out of ten you will find that these have headed the list of killed or injured. There work is hard, their hours long, their pay modest. They form a silent brigade of the industrial army that is always close to the firing line.

There remains in the operating service a great branch of the army that does not scurry up and down the line. Some of these men are at lonely outposts, forlorn towers hidden at the edge of the forest or set out upon the plain, where a desolate man guards a cluster of switch levers and hardly knows of the outer world, save through the clicking of his telegraph key or the rush of the trains passing below his perch. He knows each of these. If his is a junction tower or a point where two busy lines of track intersect or cross one another, it is his duty to set the proper switches and their governing signals.

It seems a simple enough thing, and it is. But even the simple things in railroading must be executed with extreme care. If the towerman set those switches and signals 319 times in the course of a day, they must be set absolutely correct 319 times. There can be no slurring in this work.

Those men in the towers have their own records of bravery. They are the sentinels of the railroad, and faithful sentinels they are. The lonely tower, like so many other scenes of railroad activity, gives long opportunity for thought and meditation; and so it is not so strange, after all, that one of them has recently given the

r a most distinguished essayist upon national rail-
nditions.

re are even humbler positions in the operating serv-
:h of them demanding a fine loyalty and a fair
e of ability. Even the young boy who draws a
e-truck knows that the path of advancement starts
very feet; and the humble track-walker feels that
part of the railroad safety and the railroad re-
ility rests upon his broad shoulders. His is also
rn task, as he trudges back and forth over a sec-
line, hammer and wrench in hand, looking for the
rail or other defect, slight in itself, but capable of
harm.

lay his task is dreary and arduous enough. By
is far more so. With his lantern in hand he must
he line faithfully, even if the wind howl about him
snow come to block his progress. The passengers
fast express trains that whirl past him and who
they see anything at all without, only a blotch of
park of light, do not know that it is a part of their
on. There is a deal of "behind the scenes" in
l operation.

so it goes. There are hundreds of hand-switch-
ıo make the safe path for the train and upon each
n hangs responsibility. It is a trite saying that
them knows that, and that each lives up to the
asure of his responsibility.

station-agent, even in the smallest towns, has a less
ime. He comes in contact with the outside world,
times his life goes quite to the other extreme. A
ain may be due within three minutes, and here
Aunt Mary Clark, delayed until the train is al-
histling the station stop. Aunt Mary is deaf and
her some time to buy her ticket and to ask end-
stions which must bring an endless string of an-
At that very moment the agent's telegraph

sounder begins to call him. A message, upon which the safety of the operation of that train depends, is being poured into his ear, and he cannot afford to miss a single click of that instrument; the responsibility will be his if anything goes wrong in its delivery. On top of all this some commercial traveller may be clamoring for the checking of his trunk. The representative of the railroad in the small town has to keep his wits about him in such times.

Of course, if the town is of considerable size he may have a staff about him. In such a case, he may have a baggage-room with baggageman and baggage-handlers installed; he may have assistants to mind the telegraph instrument and to sell tickets, other assistants to look after the freight. He may even attain to the dignity of a station master in uniform or else have such a dignitary reporting to him.

But in the majority of railroad stations throughout the United States the station-agent is the staff; he is lucky if he has a man to "spell" him in his "off" hours. He probably is the agent of the express company in addition, and probably the agent of the telegraph company, too, which, by arrangement with the railroad, transacts a general commercial business over its wires. There are frequent instances when the local postoffice is situated within the depot and the agent proves the versatility of his profession by acting as postmaster, too. He serves many masters, as you can see, and not all of these are outside of the railroad. He is not only answerable to the superintendent, in almost every case he is freight-agent, too, making out the bills of lading and figuring the complicated rate sheet. For this part of his work he is under the control of the general freight-agent. The general passenger-agent is also his superior officer. To him he must account accurately for his ticket sales, and that is not always a very easy matter. The question of passenger rates is a fairly complicated one.

Still, the agent must not only be able to figure the rate to South Paris, Me., or to Oshkosh, Wis., within two minutes, but he must make out a long and correct ticket within that time, while the railroad's patron demands information about some branch line connection on another system a thousand miles away. The country station-agent earns every cent of his humble salary. He works long hours; and then occasionally one of the railroad's travelling representatives will drop in upon him and casually suggest that in his leisure time he might get out and solicit a little business for the company!

There is not much loafing at the little yellow depot in the country. Sometimes a group of trainmen from some freight awaiting orders will gather there to swap stories and the keen wit of the railroad. These are the exceptions. The most times are the times of long, hard grind, work, work, work like the men out upon the trains. This railroad army is truly the army of hard work. It was gathered for labor.

Yet the station-agent leaning over his telegraph instrument in the bay of his office, and watching the Limited curry by the little depot, and seeing the president's big and gay private car hitched on behind, knows that that very executive in charge of many miles of railroad and thousands of men, came from another little country depot like this. The time may yet come when he himself will have a private car and a deal of authority. There is a great goal for every man in the railroad service.

CHAPTER XVI

KEEPING THE LINE OPEN

THE WRECKING TRAIN AND ITS SUPPLIES — FLOODS DAMMED BY AN EMBANKMENT — RIGHT OF WAY ALWAYS GIVEN TO THE WRECKING-TRAIN — EXPEDITIOUS WORK IN REPAIRING THE TRACK — COLLAPSE OF THE ROOF OF A TUNNEL — TELEGRAPH CRIPPLED BY STORMS — WINTER STORMS THE SEVEREST TEST — TRAINS IN QUICK SUCCESSION HELD TO KEEP THE LINE OPEN IN SNOWSTORMS — THE ROTARY PLOUGH.

A CUB reporter shouldered his way into a railroad superintendent's office. Outside, a late winter's storm howled around the terminal; the morning was nipping cold, the air curtained with myriad snow-flakes, a great railroad was making a desperate fight against the mighty forces of nature.

"My city editor wants to know what you folks are doing to get the line open," demanded the reporter.

The big superintendent swung in his swivel chair and faced him. It was a place where angels might well have feared to tread — a place surcharged with the electricity of fight. The superintendent's mind was filled with the almost infinite detail of the fight, but he liked the cub reporter and greeted him with a smile.

"You can tell your city editor," he replied slowly, "that it is as much as a man's job here is worth for him to think that the line is going to be opened. I 'd fire him if he as much as thought that it was ever closed. We don't die. We fight. It 's a hard storm, sonny, but we make muscle in storms like this. We don't *get* the line open, we are *keeping* the line open. D 'ye see?"

In that the big superintendent had sounded one of the biggest principles of railroad operation.

The line must be kept open. That slender trail of

two rails, stretching straight across the open land and writhing and twisting through the high hills, is a living organism. The railroad is no mere inanimate organization, like a store, for instance. It is a right-hand of the nation's life; it is life. The railroad is like a great living thing, its many arms reaching long distances back into the land. You cannot cut off the living arm and then bring it back to pulsing life.

Just so the railroad arm cannot be severed — the line must be kept open. Strange things may come to pass: the right-of-way may be littered with the wreckage of trains, brought together through a defect in the physical machine of the human; unexpected floods of traffic may seek to overwhelm the outlet; in spring the power and might of flood may descend upon it; winter's storms may seek to paralyze it; still, always the railroad must be kept open.

"We can't lie down," the superintendent explained to the cub reporter. "We 've got to get the traffic through. Do you know what it would mean if we were to follow the path of least resistance to-day — to let this storm get the best of us? Let me give you an idea of just one thing. There 's food coming in here in trainload lots every night — fresh meat, fresh vegetables, fresh milk. Folks would go hungry if we were to say 'We can't, this storm is a gee-whilicker. We give up.'"

To keep the line open, the railroad affords every sort of protective device; it trains men for especial duties.

Take the matter of wrecks, for instance. The railroader does not like to think of wrecks, but his methods for removing them must be prompt and thorough: the line must be kept open. Each year sees equipment increasing in size and weight, and each increase brings additional problems in handling wrecked cars and engines.

Twenty years ago, the wrecking-equipment of most of the big roads was comparatively simple. It was generally built in the railroad's own shops. To-day 60-ton

cars and 100-ton locomotives require something of a wrecking crane or derrick to lift them from the right-of-way; and the wrecking-train is a device thought out and built by specialists.

These wrecking-trains are the emergency arms of railroad operation. They stand, like the apparatus of a city fire department, at every important terminal or division operating plant, awaiting summons to action. You may see the wrecking-train at every big yard, waiting on a siding which has quick access to the main-line tracks. It consists of from four to six cars — a tool-car with all sorts of wrecking-devices — replacers, blocks and tackle, extra small parts of car-trucks for emergency repairs, and the like. There are more of these extra parts — axles and wheels and four-wheel trucks on a "flat" that is fastened to the tool-car; and if this wrecking-train has a couple of miles of heavy traffic line to serve, there may be three or four of the "flats" with tools and spare equipment. You cannot have too many of those in a big wreck. The wrecking-train is sure to have a crane — a big arm of steel, compressed to come within the slim clearances of bridges and of tunnels, but capable of reaching down and tugging at a 100-ton locomotive with almost no effort whatsoever. And quite as important as the crane is the cook-car — generally some old-time coach or sleeper descended to humble service on the road. The cook-car has a rough berth and a kitchen; and you may be mighty sure that there is a good griddle artist upon it. You cannot expect a wrecking-gang to get into a twenty-four hour job without being pretty constantly provisioned while it is at work.

Only a little while ago, one of the officers of an Eastern trunk-line railroad and a member of one of the State railroad commissions were coming toward New York. The trip was in the nature of an inspection on the part of the State official, but as a matter of comfort and convenience to the two men, it was made upon the former's

private car. The comfort and convenience suddenly ceased while the two were still nearly 300 miles away from the seaboard. The road rested there for many miles in heavy country; its rails found their curving way in the crevices between high hills. It had rained steadily for a fortnight; the little mountain brooks were raging mill-races. In the low flatlands of one deep valley lakes were being formed. There were long stretches where the four rails of the double-tracked trunk-line railroad lost themselves under the glassy surface of the waters. Up and down the valley trains were standing helpless between those lakes, their passengers fuming at the delay. Fast freights stood axle-deep in water; their title, for that moment, was an occasion for joyous humor. The comfortable, convenient trip of the railroad operating man and the railroad commissioner was at an end.

An embankment that the railroad had built for a branch down the valley was blocking the waters, and orders had come from New York to dynamite out that embankment. It would cost the railroad nearly $50,000 to destroy that half-mile of track but it might save the valley millions. There had been no hesitation on the part of the "old man"— the road's tried executive. That is a phase of American railroading not often brought to light.

Orders came that the engine hauling the "special" of the operating man and the railroad commissioner was to be taken for a work-train down at that damming embankment. That's the way with railroading. When the clattering telegraph keys sound the note of trouble, even that mighty soul, the chairman of the board, may find himself "laid out" at some jerkwater junction, while his pet engine goes into service with a wrecking-train. But the chairman of the board, whose time is real money, offers no protest. He knows that to block the main line costs his road $250 a minute for the first 60 minutes; that that figure doubles and trebles in the second hour;

in the third, his auditors may check off $1,000 a minute at the least, as the cost of a blocked railroad. No wonder that they insist that it is "keeping the line open."

Before the engine of that special was cut off to go scurrying down to the embankment where the skilled workmen were making preparations to dynamite away a half-mile of track, the operating man lifted his hand. He had, like any trained railroader, been listening to the clattering telegraph key.

"They 've come away without their cook — those wreckers," he told the gentleman who regulated public utilities. "I think I 'll go down with the 'eats.' There 's an old hotel across from the railroad track down at the next station, and the landlord, Uncle Dan Hortley, will fix me up."

"I 'll go with you," said the State official. "I want to get my finger in the pie."

So it came to pass that they both went, the private car stopping at the little hotel long enough to get in an overwhelming supply of bread and ham. As they whizzed through the scene of trouble all hands joined at making sandwiches.

"Butter them on both sides," said the railroad commissioner.

"They 're better with the butter on one side," insisted the operating man.

The commissioner was not used to back-talk from railroaders, no matter how high their office, and he stuck to his point.

"Both sides," he insisted.

"One side only," reported the big operating man.

"The commission has closed its hearing and issues its order for both sides."

"The railroad appeals."

But the commission won — it almost always does — and the men down at the embankment ate their sandwiches with a double thickness of butter.

Sometimes a refrigerator train comes under the skilled hands of the wreckers, and the cook-car may have more than an abundance of good material right at hand. Beef, chickens, milk — all manner of edibles have been spilled like waste along the right-of-way, and there have been no regrets among the men of the wrecking-boss's crew. Once, a speeding cook-car hurrying to the relief of the laborers upon a wrecked meat-train that had tried to go tangent to a mountain curve, brought reinforcements in the form of ham sandwiches. The wreckers were pretty hungry, but it needed all their hunger to tackle those sandwiches. The meat-train had been filled with ham; it had caught fire. Somehow, three or four hours of work hauling out smoked hams gave no appetite for sandwiches of the same sort.

On main-line divisions, where traffic runs exceeding heavy, a locomotive stands, steam-up, with the four cars of the wrecking-train. Even on side-line divisions the call for the wreckers will bring the fastest and best engine out of the roundhouse, no matter what her train assignment may be. Things on the railroad stand aside for the wrecker. Limiteds may paw their nervous heels upon sidings while she goes skimming up the line — all time-table rights are hers from the moment that she goes into service.

A wire from the seat of trouble brings her into service.

"Second Four-twelve in ditch at Grey's Bridge. Broken rail. Engine and two cars derailed. Both tracks blocked. About four killed and injured."

That wire has itself had the right-of-way. When "W-K, W-K, W-K" comes persistently calling over a railroad wire, every key closes. "W-K" is the "C-Q-D" of railroading. It is as much as any operator's job is worth, to ignore it.

When a despatch of the sort just cited comes into headquarters, things start to move. The despatcher, if he is

after the manner of most despatchers, turns to his telephone and calls the yardmaster to order out the wrecking-crew. There is no more excitement in his voice than if he were ordering out any ordinary sort of special. He rings off quickly, calls up in turn the superintendent, trainmaster, perhaps the division engineer, the claim department. If there is a fatality list — the wreck one of those fearful things that sometimes show themselves upon the front pages of the newspapers — he will get the hospitals and the doctors. The list of surgeons who are allied to the railroad in every town on the division hangs above the despatcher's desk.

He may run a special hospital train with doctors and nurses and emergency equipment. On one memorable occasion the hospital train was on its way out upon the main line before the wreck had been reported over the wire. The despatcher saw that the hospital special had a clear track; he gave a multitude of directions as to its running, with the quick clear word of a self-possessed man — then turned and shot himself dead. He had miscalculated: the human machine sometimes does. He knew that he had sent the two crack-a-jack trains on that single-track division, curling its way among the mountains, into each other at full speed. No need for him to know exactly where they met.

But even if the wreck is no holocaust; if it is one of those minor smashes that are bound to come now and then on the best of lines, he must keep his head. As he caught up his telephone to get orders to that wrecking-boss out at the roundhouse, his assistant took instant notice of the wreck, first notifying the stations on either side of the accident to set danger-signals against all trains. After that, while the despatcher himself was busied with details, the assistant arranged to handle all traffic. If both tracks were blocked, there were plans to be instantly made to forward the fast through trains by detouring them over other lines of railroad. The assistant despatcher, wish-

THE WRECKING TRAIN READY TO START OUT FROM THE YARD

"TWO OF THESE GREAT CRANES CAN GRAB A WOUNDED MOGUL LOCOMOTIVE AND PUT HER OUT OF THE WAY"

"THE SHOP-MEN FORM NO MEAN BRIGADE IN THIS INDUSTRIAL ARMY OF AMERICA"

ing to know how long he could afford to hold his heavy traffic (remember that the line must always be kept open), wired the nearest station for additional details. Most of all he wanted to know how long the tracks would be blocked. Perhaps before he got his wire through there came a second message from the wreck, giving more facts about it. By means of code, great detail can be given in a short wire; headquarters gets a clear understanding of the trouble. After that the wire chatters constantly; there are a thousand orders to be given, a thousand details to be arranged.

While the first of these wires are beginning to swing back and forth the despatcher will hear the wrecking-train, pulled by the neatest and swiftest bit of motive power from their big roundhouse, go scurrying by down the line. The road is cleared. Everything stands aside, and for weeks after, the stove committee in every roundhouse on the division will be telling how she made the run.

They don't talk about the run when they get to the accident. They pile off the train and get to work quickly. Every man is a trained wreck-worker, as a fireman is trained to his peculiar business. In such hours as they are not out on the road, the wreckers are repairers of cars. It keeps them busy during the long seasons when the line is lucky and has no wrecks, and it gives them the skill with which to tackle the difficult problems that confront them after a smash. By day these men — eight or ten or twelve of them to a crew — work in the yard close to the waiting wrecking-train; by night the telephone at the head of the bed of each man will bring him quickly to the near-by yard.

"How do you handle a wreck?" we once asked an old-time wrecking-boss, a man grown gray in keeping his line open.

"I don't know," was his frank response. "I 've probably handled a thousand wrecks — perhaps more — but

I have yet to see two that were the same. Different cases demand different treatments. Any surgeon will tell you that; and you know," this with a bit of a laugh, " we are the surgeons of the steel highway.

" We 've only one rule that is absolute, and that rule is to take care of the folks who are hurt in the first place, and in the second place to get the line open. If it is multiple-track line — two or three or four tracks in operation — and the muss is sprawled over the entire right-of-way we get a through track working in shortest interval. When we can wire " number two open " or whatever it is, the despatcher down at headquarters will catch the stations where there are crossovers and he 'll be handling his first-class traffic of all sorts past us while we 'll still be stocking the arm of the old bill crane down into the smash."

The arm of that crane can lift a freight-car — if there is enough freight-car left to lift — off the rails and into the ditch in almost a twinkling. Two of these great cranes can grab a wounded mogul locomotive and put her out of the way. The wrecking-trains on a first-class road are kept along the line in profusion. Each is supposed to cover a territory of 100 miles or so in every direction from headquarters, and a sizable smash will bring two or more to work in unison. Two wrecking-cranes working into the remnants of a head-on collision from each direction can accomplish marvels. They will come together finally at the chief test of their strength — the point where two locomotives have firmly locked horns in dying embrace. That is a point that finds the nerve and ability of every wrecking-boss.

But all these wrecking-bosses have nerve and ability. They could not hold their jobs without both. They know when equipment — cars that might be made as good as new in the shops — must be burned like driftwood, and when the burning of a wreck would be criminal waste. *That* requires judgment — judgment to determine whether

it is cheaper to burn than to lose valuable time; to delay traffic on a main-line division or to let the traffic on a less important side-line division wait for a little longer time. Judgment is part of a wrecking-boss's equipment. His superintendent knows that; and when the super grows nervous and gets down to the wreck himself, although he knows that he is ranking officer in charge of the work he shows good judgment, on his own part, in letting the wrecking-boss give all orders. That makes for skill, it makes for speed. If the wrecking-boss is not doing good work the superintendent can fire him to-morrow, or (what is far more usual) find him an easier berth somewhere on the division.

There are times when the work-train must be summoned, when laborers by the dozen must get to work to build new track. A wash-out may require a half-mile of track to be laid in a night, and the railroad can do it. A young man wrote a very able story for *The Saturday Evening Post* a few months ago, in which he told how an emergency track was laid across a highway bridge and a test fast-freight put through on schedule. That feat was but one of the many ordinary tasks that come in the lifetime of every operating man.

Clearing a wreck may be a tedious business.

There is a deep sink on the parade-ground of the Military Academy at West Point that is a monument to the nastiest railroad wreck from the point of view of time, that the Eastern railroaders have ever known. Just under that parade-ground the West Shore Railroad passes through a long tunnel. On an October night more than twenty years ago, the Chicago & St. Louis Express of that railroad was slowly poking through that bore, when a portion of the roof of the tunnel collapsed. It buried itself between the rear part of the baggage-car and the forward part of the express-car and the train came to an abrupt stop.

Engineer William Morse saw in an instant the damage

that had been done. He cut loose from that pennec baggage-car and made record speed up the line to Corn wall, the nearest station. From there he a sent a wir post-haste to the despatcher up at Kingston, then the hea c quarters of the line.

"Train caught by collapse of West Point tunnel," tha despatch read in part. "Only engineer and fireman es caped."

They began to get their hospital train ready at Kings ton, notified Newburg to get all the doctors in sight and hurry them on a special to West Point. The chief despatcher went through the worst quarter of an hour of his life. He began to call Weehawken, the southern terminal of the line. Weehawken wires were all busy, and he could not cut in there.

Weehawken wires were getting reports from Conductor Sam Brown of the Chicago & St. Louis Express, who had come running out of the tunnel to the West Point depot.

"Wire headquarters," he shouted to the agent, "that we 've run into an avalanche. Morse and his fireman are crushed under the tunnel roof."

And they began to get the wreckers busy down at Weehawken.

When the chief despatcher up at Kingston finally got Weehawken, they told him about Sam Morse's fate. The truth of the thing came to him in an instant. He laughed hysterically, and his assistant jumped up. The despatcher's bad quarter of an hour was over. He jumped to his telephone, caught the yardmaster with it.

"We won't need that hospital train," he said. "There is n't a soul hurt."

And there was not. But there remained the worst rail road block on record. It was three months before they pulled the baggage-car out of that tunnel, and then they had to use dynamite. After that it was found necessary to line the entire bore with solid masonry. That was

an accident that might not have been so lucky on repetition.

Enough of wrecks. They are not the only test when it comes to keeping the line open. Sometimes a crippled telegraph service may be quite as effective. Out on the Pennsylvania lines west of Pittsburgh a couple of years ago a severe wind and sleet storm levelled more than 40 miles of telegraph poles, in most cases dropping them across main-line tracks in the dark. A few months later — the never-to-be-forgotten inauguration day of President Taft — a similar storm did similar work on the lines leading to Washington. Thousands of militiamen and excursionists never reached the inauguration at all. In both storms the resources of a great railroad were well tested.

An old-time Erie man remembers wire troubles of a different sort. It was in his salad days, when he was serving as assistant superintendent over the Meadville, in the western part of Pennsylvania. They had but one telegraph wire for railroad purposes on the division then, and one night it "grounded." Keys were silent, the road might as well have had no wire at all.

The assistant superintendent started that evening with two linemen on a hand-car to find that "ground." They went miles from Meadville, and every test showed the wire working. Finally they came to a deserted little depot at a cross-roads and the railroader lifting his lantern high against the window verified his suspicions: the careless agent had gone home and left his key open. The superintendent broke open the window, climbed in, removed the telegraph set, placed it in his overcoat pocket and closed the circuit. He knew that he would hear from the agent on the morrow. He did. Word came by tedious train mail, a formal report on the road's yellow stationery.

"Station at A—— burglarized last evening," that formal report read, "and agent's telegraph set, best pants, and ten dollars taken."

The real test of keeping the line open comes when winter descends upon the land, when the heaviest freight traffic of the year comes, together with those forces of nature that sweep off the summer joys of railroading. The mighty battles of the western transcontinentals with the snows of the Rockies have long been known, their miles of snow-sheds making safe crawling bores for through trains under the snow-banks, and the avalanches of the mountain-sides are as familiar to the tourist as the Great Salt Lake or the wonders of the Yellowstone. Only a few months ago the newspapers told the story of how a passenger train, stalled at the entrance of a Washington tunnel, had been carried by an avalanche down a great cliff. Every railroader, east and west, knows full well the hazard of mountain line in the depths of a treacherous winter.

There is a snow-belt extending around the south edge of the Great Lakes that annually gives the Eastern railroad men a good opportunity to sympathize with the Westerners. Long years ago a little railroad reaching north in this belt from the main line of the New York Central became discouraged in the all but hopeless task of keeping its line open. It had been a hard enough battle to find the rails of its main line from Rome to Watertown through one blizzard crowding upon the heels of another. There had been ten days when Watertown was entirely cut off from the world to the south of it. But that little railroad owed some obligations to its chief town, and it kept at its brave efforts although every night the fresh wind blowing down from the Canadas across Lake Ontario filled the long miles of railroad cuts, and nightly erased all trace of rails. But there was a branch from Watertown to Cape Vincent run at a dead loss

throughout the entire winter, and in that hard winter the railroad gave up the branch, and hired a liveryman to take the mails in his cutter over the country drifts. It was one of the few instances on record of a railroad giving up the fight.

After the railroad had been abandoned a fortnight a delegation of citizens from Cape Vincent drove to Watertown and there confronted H. M. Britton, the general manager of the line. They made their little speeches, and those were pretty hot little speeches — hot enough to have melted away one good-sized drift.

"When are you going to cart that snow off our line?" finally demanded the spokesman of the Cape Vincent folk.

Britton looked at the delegation coolly, and lighted a fresh cigar.

"I 'm going to let the man that put it there," he said slowly, "take it away."

And he did. It was thirty-two days before a railroad engine entered Cape Vincent from the time that the last one left it.

In recent years, that nasty stretch of railroad line has kept the railroaders still busy. Within the decade it was blocked for six long days, while a force of snow-fighters and a battery of ploughs forced their way into the drifts. And while the superintendent up at Watertown grew nervous, then desperate, there came the worst blow of all: the telegraph wire no longer brought news from the front.

Afterwards that super knew the reason why. His train-master was at the front with ploughs and the hungry, tired, straggling men. The train-master was nervous, too, wearied explaining to his boss. He remembered Dewey at Manila, and he cut the cable! He lost sight of the outer world for long hours, for days, for nights, until that January evening when he brought his battered snow-fighting force triumphant into Richland Junction.

When a big road whose rails rest through a sno finds the winter clouds blackening, it puts on its fi armor. Every man at headquarters sticks by his The superintendent will get bulletins from each te and important yard every hour, perhaps oftener. bulletins will give him exact information — the amc motive-power ready at each roundhouse, freight c tion, if any, amount and direction of wind, clou snow conditions.

In other days the signal for an oncoming stor followed by quick orders from headquarters to pull snow-freights. Traffic was quickly cut down to pas and perishable-freight trains, and, if the blizzarc bad enough, the perishable-freights were run in up sidings. The railroad concentrated its motive-powe the passenger trains and the ploughs. Nowadays t it better. Not that the old fellows of the last gen were anything less than prize railroaders, for ren they did not have the locomotives in those days tha side-line divisions possess in these.

So to-day the superintendent can growl at the firs men who even hints that a scheduled train of any c sent upon a siding.

"We keep the traffic moving," said one of the the other day. "We keep the line open. A trai thirty minutes over our rails will do more toward l them usable than a rotary going over them after a inaction.

"So when she begins to blizz, we just fall back roundhouses, that 's all. We cut our local freight to 1500 tons, then to 1200, 900, 600, rather tha them into shelter. We tackle our through freigh like proportion and while we are cutting off cars, adding power. Everything that goes out of this ya be double-headed as long as there is danger in t There will be two engines to a passenger-train and of each a rotary, with two or three locomotives t

. You see the value of reserve motive-power, don't
? Why we have half-a-dozen extra engines trying
gather rust over there in the roundhouse. They 're
th their weight in gold in a pinch of this sort, though
n they 're done with a week of snow fighting, they 're
andidates for the shops."

rotary plough has no powers of self-propulsion, but
mighty engine within her heart, driving the shaft of
great cutting-wheel has the power of three locomotives.
t cutting-wheel approximates the width of a single-
k in diameter. It will bore into a solidly packed drift,
ve or sixteen feet in height, suck in a great volume of
v, and then throw it — as a fire engine throws water
hrough a nozzle 60 to 100 feet to the right or left
he line. The nozzle is close to three feet in diameter,
the stream that it throws will bury a small barn. The
who sits in the lookout of the rotary controls the
le, changes it from side to side so as to avoid build-

hese rotaries are giants. Where the great flange or
ploughs — the ordinary snow-fighting artillery of a
oad — fail, they come into service. Theirs is ever
ghty task to perform. We have seen a rotary spend
minutes in going sixty feet through a heavy drift, a
three miles long and twenty deep. Snow can drift,
wet snow can pack, pack until you almost begin to
of dynamite as a resource.

hree days of such snow-fighting would completely
y the ordinary man. Up in the snow-belts, they are
y to get a hard storm every week from December to
ch, and that atop of the heaviest traffic of the year.
the sort of fighting that marks the fine-grained timber
man; that sends him down to headquarters in some
opolitan city along the seaboard, to fight the weight-
battles of traffic and of operation, which are
ding within and between the mighty railroads of
rica.

Sometimes the battle to keep the line open is fought close to a busy terminal. Here, before you, once again, is the division superintendent of one of the great lines entering Jersey City. Let him tell you of the nasty storm on Christmas night last, a storm that laid low all street transportation in every city along the North Atlantic seaboard. He will tell you how it was the first Christmas that he had spent with his family in seven years; the first holiday in three. He lives in a little suburban city within the 20-mile radius of New York City Hall, and in his bedroom a telegraph sounder, connected with the division's main wire, clicks in the early morning and late at night.

Over that wire on Christmas night last, the superintendent gave orders. There was snow in the air at dusk when they finished their late afternoon dinner; by eight o'clock he had ordered the flanges (ploughs) on all his regular road engines. Along the entire line orders had gone to keep a sharp lookout for trouble. The superintendent turned into bed at ten o'clock, hoping for a clear winter's sky in the morning.

He turned into bed but not into sleep. He had cut out his telegraph wire for the night but a telephone message from the agent down at the depot in the suburban city made him sit up wide awake. The storm was gaining. They were beginning to get trouble reports down at headquarters. The superintendent turned out of bed and began dressing. He cut in on the telegraph wire and began giving orders.

He caught his train-master at the neighboring town and told him to meet him at 495, the last train into Jersey City that evening. He turned from the telegraph to the telephone and ordered the local livery man to get up to his house and take him down to the 11:42. He called the depot agent to hold that 11:42 until he arrived.

When that superintendent came puffing into his office in the Jersey City terminal it was one o'clock of a blizzardy Sabbath morn. He dropped into a chair beside his chief

"WINTER DAYS WHEN THE WIND-BLOWN SNOW FORMS MOUNTAINS
UPON THE TRACKS"

"THE DESPATCHER MAY HAVE COME FROM SOME LONELY COUNTRY STATION"

"THE SUPERINTENDENT IS NOT ABOVE GETTING OUT AND BOSSING THE WRECKING-GANG ONCE IN A GREAT WHILE"

despatcher and took the entire situation in hand. Things looked pretty bad from every point of view. From up in the foothills came reports of discouraging nature, trains were losing time, they were having added trouble every hour in handling switches and cross-overs. At the terminal the switches were a most prolific source of annoyance. The intricacy of the interlocking system was being bothered by ice freezing about its exposed working parts.

The superintendent was perplexed, but he did not show it. He kept lighting cigars and throwing them away half-smoked. And all the while he was sending orders over his wire. If a narrow strand of steel, stretching for miles through darkness and through storm could carry infectious courage, that wire carried the superintendent's courage out to every far corner of his division through those early hours.

"Keep at it," was the tenor of his message. "Keep everlastingly at it."

And between times he was planning how to help them to keep everlastingly at it. Men were summoned to report Sunday morning at the shops — they might need to make some quick repairs, and it is a matter of record on that division that a locomotive has been torn apart, entirely overhauled and placed in service again in twenty-four hours — others were ordered to stand by important switches against breakdowns in the interlocking.

There were special problems in plenty to be considered, a new one arising every hour. One of them will suffice to show the measure of that superintendent's problem that night.

Up in a narrow pass between overhanging hills a much-delayed local, with a light road-engine, was still struggling to get the Christmas celebrators home. It was a hard proposition; and just a block back of the suburban train was chafing the midnight express through to Chicago — one of the road's best trains. The superintendent saw in an instant that his main line stood in imminent danger

of being blocked. He caught Middleport, the station ahead of the struggling local, and ordered it side-tracked there for a moment.

"I want to get that midnight with her big engine ahead from there," he explained to his despatcher.

But the towerman at Middleport said that he could not move the siding-switch there; it was packed in with ice and snow.

"Tell him to get a pick-axe and shovel and get in at it," said the superintendent.

"He says that it 's 20° below up there; they 've swiped his shovel, and he has n't anything but a broom," the despatcher returned.

"A broom! Tell him a broom 's a God-send. He can sweep with the one end and pick with the other."

Eight times that towerman tried there in the midst of the storm to open that switch and eight times he reported failure. Eight times the superintendent kept at him with his kind persistence, and the ninth time they reported that the midnight express with the best type of motor power on the division was ahead of the weak engine on the local.

And while the superintendent struggled at the far end of a telegraph wire with that towerman, there were a dozen other Middleports, each with its own different and equally difficult problem. Each required quick, intelligent solution. He solved each. The line stayed open. The superintendent stayed at his desk.

All that Sunday it snowed, and all that Sunday the superintendent was at his desk. He did not know the passage of the hours; the clicking sounder held his attention riveted. He worked all Sunday night and into Monday morning. There were 200 suburban trains to be brought into the terminal on Monday morning, and the commuter is a fussy soul about his train being on time. The superintendent knew that, and he was ready. He had extra men at the switches in the terminal yards, took

ılar pains to have snow swept from the platforms
ɔn the lowliest suburban station.
e trains came in on time that Monday morning, all
ɔne. On that one train the regular fireman had been
ɔound at his home upon the mountainside. They
o put on a green man to fire the engine — a raw-
lad just off a freight. He made slow work of it,
he train was fourteen minutes late. That was the
xception to a clean record, a record made possible by
ıours of work.
'hey ought to have been proud of that fight," you
the big boss. He grins at your ignorance.
'roud?" he laughs. "They raised hell with me be-
we had 387 laid out fourteen minutes."

thing. The man who had held the job was in almost every way absolutely efficient. He had been reared in the routine of his office; he knew its vast details as well as any man might ever hope to know them. But he was a detail man, and there he stopped. The road needed more of a figurehead, a better advertiser. The late George H. Daniels was in many respects the best passenger agent that American railroading has ever known. He was the forerunner of the general passenger agent of to-day — a well-known figure in the great State that his railroad served, being interviewed by reporters — and lady reporters, too — on every conceivable subject in the public eye; addressing dinners in metropolitan New York, or in suburban Yonkers, or anywhere else in the State, with rare facility, yet now and then adroitly bringing in reference to the "four-track trail" by which he was employed.

Other roads took heed of Daniels. The general passenger agent became less and less a man of office routine and of ticket detail, more and more of a public figure. He called Mayors of important cities by their first names; he kept close to the pulsing heart of the public press by friendly intimacy with the reporters; spoke at two, three, four dinners a week. The Prince Charming of the railroad is, indeed, a development.

But behind the smiles of this prince, behind the phraseology of words spoken or written that glorify "the road," there is a serious aspect of his life. He must capitalize that splendid urbanity, that jocose wit, into ticket-sales. In the beginning he was created to sell tickets, and sell tickets he must. On his ability to sell tickets, and not as a popular public figure, will he be measured by the board of directors — that delegation of grim-faced gentlemen, who place small market value on either urbanity or jocosity.

So, while the general passenger agent presents his smiling face to the outside world, he is a man of system, no mean executive there within the inner. He must organize

to sell his tickets. There is an inner organization of no small moment in the passenger office of any sizable railroad. In the first place, the area from which traffic is to be drawn is divided into districts. General agents or assistant general passenger agents (the title varies widely on the different railroads) are assigned to each. This traffic area is far larger than the area covered by one railroad system. It is generally nation-wide, while some of the biggest of our railroads maintain ticket-offices in the large cities all the way around the world. They are today fighting almost as sharply for American traffic in Paris or in London as they fight in Clark Street, Chicago, or in Broadway, New York.

For it is a fight and an endless fight, which the Prince Charming — he of the urbane smiles — must wage. Despite the constant consolidating processes of our railroads, there are few large territories that are the exclusive field of any one road. The most of them must fight for their business — particularly for their profitable long-distance business. The fight divides itself between the freight and passenger traffic departments. No wonder, then, that the general passenger agent must be a many-sided man.

From his district offices, there scurries forth a corps of smooth-tongued, quick-witted young men — the travelling passenger agents. These young men are skirmishers. They are up and down the steel highways of the nation, thirty days out of the month, skirmishing for business. Each carries in an inner pocket a wad of annual passes — such as might make any statesman green with envy. Those passes cover every steam line in the territory that is assigned to him and are return courtesy for the neat little cards which his road in turn issues to the traffic solicitors of other roads.

In other days these skirmishers carried forth business which sometimes approached cut-throat tendencies. The weaker lines in hotly competitive territory — lines which, running fewer high-grade trains and running them at

slower speed — which were naturally at a disadvantage, sought to obtain at least their normal share of passenger traffic, by sharp work. After that their stronger brethren often showed their religious belief in fighting them by fire. Tickets were sold at less than advertised rates to certain favored individuals; sometimes a few passes, adroitly placed, did the business. In these days those sharp things are forbidden, and the young man, soliciting railroad traffic, who breaks the rules of the game runs the risk of worse than facing an angry boss, getting discharged; perhaps he can see the doors of a Federal prison opening for him.

So the fellow who skirmishes for the weak road has a hard time of it in these piping days. Passenger traffic, like kissing, seems to go by favor nowadays; and how hard the travelling passenger agent works to curry that favor! He drops off a local at some way-station, there is a smile and perhaps a cigar for the country-boy who sells tickets there, for the Interstate folk have not sent any one to prison yet for offering either a smile or a cigar. The T. P. A. knows that the local agent cannot, under the rules that govern him, recommend routes that connect with and extend beyond the line which gives him employment. Still, sometime the country agent may be approached by a man who demands that a connecting road be suggested for him, and the T. P. A. can see that man, without even shutting his eyes. If the country agent will only remember the nice T. P. A. that the Transcontinental sent in there a month before, and the good kind of cigars he dispenses, the Transcontinental may get a part of the haul on a long green ticket. Perhaps the man will be taking his wife, and there will be two of the long green tickets. Perhaps there will be a whole party to be routed over the Transcontinental — the T. P. A. can imagine almost anything as he swings overland in the dreary locals from way-station to way-station.

Sometimes a wire from his chief quickly changes his

schedule. The Magnificent Knights of the Realm — or some other impressive order of that sort — are to hold their annual convention at Oshkosh, and the T. P. A. must hustle down to Bingtown to see that Transcontinental gets the haul of the delegation that will go to Oshkosh from the bustling little community. He scurries into Bingtown to locate the officers of the local lodge of the M. K. O. R. there. On the train there may be a T. P. A. from some rival system — they are all partners in misery. The Transcontinental man will probably drop off the opposite side of the train at Bingtown from the crowded depot platform — it 's an old trick of the T. P. A.— and be tearing over the pages of the Bingtown directory before that train is out of town again. Once located, the officers of that lodge of M. K. O. R. must be pleasantly instructed in the advantages of Transcontinental — the speed of its trains, the safety of its operation, the convenience of its terminals, the scenic splendors along the way, the excellence of its dining-car service; all these things are spun with convincing eloquence by the travelling passenger agent.

A few years ago, two travelling passenger agents, whose lines supplement one another to make a through route across the continent, went down into an Eastern manufacturing city to land business bound west to a national convention of one of the biggest of the fraternal orders. There were other passenger men heading toward that same territory, and the two men from the connecting lines made an offensive and defensive alliance. When they reached this town, they found that the chief officers of the local lodge were two city detectives and a police justice. All three of the city officers showed little enthusiasm about the coming convention. The passenger men took off their coats — figuratively — and pitched in.

For three days, they ran up an expense account that must have all but paralyzed the auditors of their companies, but they accomplished results. After the first day

entertainment, the police justice said that there would an even dozen of them for the three-thousand-mile run, ıich was going some. Most passenger men would have sted content on those laurels, but this combination used at first day only to whet their appetites. They started iskly out on the second, a little fagged, but still in fight- g trim, and by that night the two detectives united in omising one or two filled Pullmans. The third day saw e two traffic solicitors nearly dead, and the well-seasoned y officials just in fine trim. The trim must have been e, for that night they completed arrangements for one the biggest special train movements of that year: two ndred and fifty enthusiastic brethren went three-quar- s of the way across the continent and back as a result the work of these passenger men.

Once a travelling passenger agent went nearly too far this entertainment business. He got business, miles d miles and miles of it, but he also got drinking far) heavily. One day, when he came into the general ices very much the worse for entertaining, he bumped o no less a man than the president of the road. That sident was a strict old soul. He had church connec- ns, and he used to lecture his Sunday School class on evils of the liquor habit. He decided to make an ex- ple of this young whelp of a passenger agent from off road.

But just as the sentence was about to be pronounced, the ıeral passenger agent interfered. He went straight to president and the wrath of an honest man was in his

'We don't intend to have drunken men working here," president kept saying. "It 's the example —"

'If he drinks," said the G. P. A., "it 's my fault, and n the man to let go."

The president let his eyeglasses drop in astonishment. 'You?" he said.

'I 'm guilty," said the G. P. A. "This man goes

everywhere to get business for us, and he gets it. I
kneels with the preacher, he talks high art with the Brow
ing societies, and he gets drunk with the drinkers —
in the name of this railroad system. Now we propo
to kick him out, still in the name of this railroad system

The president saw the point, and together they took ho
of the T. P. A. and made him a decent, sober man. T
day he is one of the most efficient officers of that ve
road, and he owes it all to that broad-minded G. P. A

Geniality, urbanity, courtesy are the major part of
travelling passenger agent's equipment, as they are pa
of his chief's in these days, when the rates have ceased
enter into the fight for traffic.

Rates?

The rates must be the same nowadays by all routes
the same class; and so the T. P. A. *must* bring out the e
cellence of his line, leaving none behind because of a fal
sense of modesty. He is silent about other roads, save
they may lead to and from the system that he represent
You want to go to Kickapoo. You could go to Milltow
by the Transcontinental and get from there to Kickapo
most easily by the main line of the St. Louis Southwester
but the travelling passenger agent frowns his first frow
at the very suggestion. The St. Louis Southwestern is th
worst competitor that Transcontinental has for passenge
traffic, and the T. P. A. does not propose to send busines
over its rails. So he ignores your suggestion.

"We have our own line into Kickapoo," he tells you —
the old smile returning. "You won't have to leave Trans
continental."

And such a line! It happens to be a branch of th
worst jerkwater type. To reach Kickapoo over Trans
continental you must go to Milltown and change from th
mfortable Limited to a less comfortable train, whic
es you to Quashalong Junction. There you find a sea
local which jogs along at twenty miles an hour for th
ter part of the afternoon until you get into Miller's

Forks. When you reach Miller's Forks you almost abandon hope. For the thirty-mile stretch from that cross-roads over into Kickapoo is a grass-grown stretch of half-neglected track over which a combination freight and passenger-train — adequately described on the time-card as mixed — ambles once in twenty-four hours. By the time you have finished that trip you will have arrived in Kickapoo without leaving the rails of the Transcontinental, but you will also probably have registered a vow never to travel on them again, if they can be avoided.

Right there is a traffic mistake. If the T. P. A. had been wise he would have swallowed his hatred of St. Louis Southwestern and recommended that you use it for that stretch from Milltown to Kickapoo. He let his zeal for his road overrun his business judgment. A good many of them do. Only the other day a man walked into a railroad station of a small city in the Southern Tier of New York State and announced that he wanted to hurry through to Binghamton.

"We have a train in five minutes, our 12:12," said the agent, all smiles.

The man hesitated. He wanted to do two or three errands in that small city before he went on to Binghamton, and so he asked the leaving time of the next train.

"Nothing until 6:18," the agent told him.

"That will be too late for me to get into Binghamton," the passenger said. The agent did not reply, but turned his attention to other persons who were waiting at the ticket-window. But the man from Binghamton was still perplexed. An agent of the news company who ran the stand in that station, came over and helped him out.

"The — (mentioning a rival and paralleling road) gets a train out of here for Binghamton at 3:30," he explained.

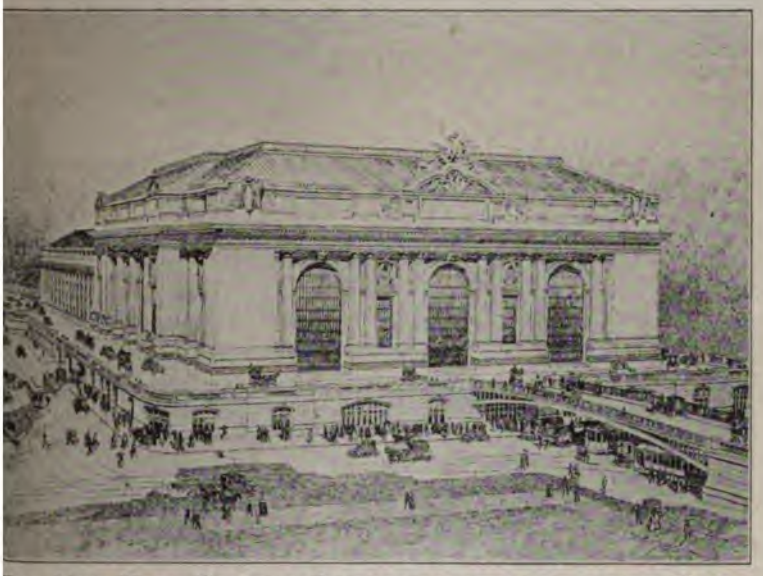
The passenger thanked the news-agent, for his problem had been lightened and started out for the other station.

When he was gone, the ticket-seller summoned the newsman and threatened to have him fired.

But there is a new order of things coming to pass even in this hot rivalry for getting passenger traffic. Long ago, C. F. Daly, who is to-day vice-president in charge of traffic for the New York Central lines, was in charge of the city ticket-office of the Burlington, in Omaha. Those were days when no loyal traffic-man was ever supposed even to breathe the name of a competing road. But Daly held his loyalty firm, and still went straight against that absurd rule. If a woman came into his office and, after the way of some women travellers, finally decided that she wished to travel over the rival Northwestern, he would not let her get out of his office. He would give her a comfortable seat, and perhaps a magazine or paper to read, and send one of his office-boys over to the Northwestern office to buy a ticket for her. Sometimes before the office-boy could get out of the place the woman would change her mind in favor of the Burlington. If she did not, Daly did not worry. He knew that he was of the new order of railroaders.

Come back, for a final moment, to the travelling passenger agent. He may be forgiven an over-zeal for the line which employs him, for that has been his training from the beginning, and — which is far more to the point — he is being measured by the results that he accomplishes. The road does not pay him a salary and pay his heavy expense account (which the auditor generally permits to contain various unvouchered items for entertainment) without expecting results.

If he is a new man in the territory, he is measured against his predecessor. Afterwards, he is measured month by month, against the corresponding month of the preceding year. All tickets which were sold from his territory, and in which his road shares, are credited to his influence. It becomes a matter of cold calculations and of



THE NEW YORK CENTRAL RAILROAD IS BUILDING A NEW GRAND CENTRAL STATION IN NEW YORK CITY, FOR ITSELF AND ITS TENANT, THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD

THE CONCOURSE OF THE NEW GRAND CENTRAL STATION, NEW YORK, WILL BE ONE OF THE LARGEST ROOMS IN THE WORLD

SOUTH STATION, BOSTON, IS THE BUSIEST RAILROAD TERMI
THE WORLD

THE TRAIN-SHED AND APPROACH TRACKS OF BROAD S
STATION, PHILADELPHIA, STILL ONE OF THE FINEST OF AME
RAILROAD PASSENGER TERMINALS

dollars and cents. If this April does not show an increase over April of last year, the T. P. A. must make a mighty good explanation to his chief. It will have to be famine or pestilence or something nearly as bad to justify the slump in ticket sales. An insinuation on his part that a reduction of the service of his road was responsible for the slump would never be accepted at headquarters.

So, all in all, the life of the travelling passenger agent is no sinecure. It is easiest when he is in the home territory of his road, rather pleasant when that road is non-competitive. But when he is out in "foreign" territory, fighting for a road which is hardly more than a name to the folk with whom he comes in contact, his difficulties increase; when, if his road is one of the weaker fry, its trains slower and less frequent than some of the other trunk-lines, his difficulties increase. The differential-fares by which the slower competing roads are permitted by their stronger brethren to charge a reduced rate between important distant traffic points were adopted to help to equalize this difficulty. But the differentials do not count, neither do the differential lines now get their share of the through business. Last year fifty per cent of the passengers between New York and Chicago went on the eighteen-hour train, even though the regular full fare of $20 in each direction is increased by an excess fare of $10, aside from the Pullman rates. Twenty-five per cent more travelled on the limited trains, which makes an excess of $5, in addition to Pullman rates, in each direction. It begins to look as if the American public were willing to pay for added comfort and convenience. Pullman operation has doubled within the past ten years. Pullman chair-cars are operated to-day on hundreds of miles of branch line railroads that would not have dreamed of such a luxury a decade ago.

In fact, we are moving toward first-class and second-class passenger service by leaps and bounds. Less than twenty years ago the New York Central established its Empire

State Express between New York and Buffalo, and, by means of the almost marvellous resources of its advertising department, made it the most famous train in the world. Save for a single parlor car or two, it has always been a day-coach train, no excess fare being charged. Yet for many years (in recent years its running-time has been slightly lengthened) it was the fastest regular long-distance train in the world. Still, in the judgment of railroaders to-day, another Empire State would be a mistake, even though the original is, day in and day out probably one of the most popular and profitable express trains in the world. But the judgment is different: the Lehigh Valley, running the competing Black Diamond, between New York and Buffalo, has already found it advisable to make its equipment all Pullman.

Just as the travelling passenger agent forms the stock from which many of the general passenger agents are finally formed, so does the country agent aspire to the day when he will be given territory and sent out with his gripsack, to sell transportation upon the road. Sometimes, though, as in Daly's case, the road to traffic titles comes by way of the city ticket-offices. These form an important function of the railroad's passenger department. They are regulated carefully, through an inter-railroad harmony, as expressed in the great national passenger associations. We have already seen how they sell mileage-books and "scrip" on their own account. For instance, a sort of tacit agreement specifies how many ticket-offices a railroad may maintain in a given city. Otherwise, the biggest and richest road might completely overshadow its weaker neighbor in the number as well as in the magnificence of its agencies. So an unwritten agreement, which is as strict in its way as the law on cutting rates, states that this city may have so many offices for any road, and that so many. It has become an exact rule.

The city ticket-offices, situated at advantageous corners

in the various busy centres of metropolitan towns, and towns having metropolitan ambitions, save the average man a long trip, perhaps, to the station. They will sell tickets, check baggage, answer innumerable questions. Answering questions remains one of the big functions of the passenger-man.

Only recently, a sign was hung in a city ticket-office of one of the large railroads in New York, which read:

"Remember that we are Here to Sell Tickets as well as Give Information."

That sign was a mistake. It was an affront to every person who entered that ticket-office, and remember that every person who enters a ticket-office is at least a potential passenger for the railroad that operates it. It is only charitable to believe that the agent meant to say: "Remember that we are here to give information as well as to sell tickets," for the giving of information is a function of a passenger ticket office. So important has this function become, that the railroads have established desks in the largest of these city offices at which no tickets are sold, but where questions are answered and railroad, steamship, and hotel folders given out. "Public Service stations," the New York Central has begun to call its city ticket-offices and, furthering this idea of courtesy and affability, its general passenger agent has opened a school for the training of its agents. They are taught to answer questions quickly and accurately, and to be, above all things, courteous to the persons who come before them and the potential travellers.

Just a final look before we leave this passenger department, at its equipment. Its complications are large. Take this matter of tickets, for instance. While the financial department of the road will receive the money that comes in for their sales, and the auditing department takes good care as to the accuracy of the agent's returns, the passenger department has charge of printing and issuing

the contract slips by which it agrees to convey its passengers. There is a multiplicity of forms of these, each bearing the signature of the general passenger agent.

On smaller roads, the number of forms of local tickets is greatly reduced by writing or stamping the name of the destination on tickets. On a single branch line, with 25 stations, just 600 different styles of printed railroad tickets would be required otherwise; you can imagine the number of styles required for an average system of 1,000 stations. Fortunately, for the passenger department, the use of simplified forms of tickets, where adroit cutting and tearing makes possible the use of a single ticket form for an entire division, has reduced the big ticket-printing bills. Only recently, a machine, on the order of a cash register, has been invented, from which a ticket, accurately stamped and dated, with the destination indelibly printed, can be delivered as demanded.

Still, with all these simplified forms of tickets, a big road will hardly carry less than 5,000 standard forms. Then there will be anywhere from a dozen to twenty special forms a week that will have to be printed — for excursions, conventions, and special train movements of every sort. The ticket-printing bill of a big road will easily exceed $40,000 a year. Its folders will cost not less than $50,000, while the twelvemonths' bill for newspaper advertising will more than exceed the combined figure of these two.

All these details come under the jurisdiction of that urbane general passenger agent. He supervises, in another department, the making and the readjustment of rates — this last a seemingly endless task.

To make up rate-sheets, either in the freight or in the passenger department, requires expert work. The fare between the same points on competitive railroads must, in the present order of things, remain equal. To cite an interesting instance: The A—— railroad long ago established $6.00 as its passenger charge from N—— to

S——. The B—— railroad, although charging a higher rate per mile over its line, is obliged to meet this rate of $6.00 in order to secure business from N—— to S——, even though that makes many perplexing problems in its local rates. The B—— railroad mileage from N—— to S——, up its main line, is 288 miles — practically the same as that of its competitor. For the 146-mile ride to G——, the first large way-station, it charges $4.50, for the 208-mile ride to M——, the next, $5.00. If a man were to go over its line to S—— and stop off at G—— and M—— his fare from N—— to S—— would be $8.80. That is a typical case, and one that is repeated in every corner of the country. Where a road comes into competitive territory its rates must adjust themselves to those of its lowest-priced rival, otherwise it could hardly hope for a fair share of the business. So the rates must shade here and there; the rate-clerk must take good care to see that wherever it is in any way possible, no combination of tickets can be formed that will sell at less rate than a through ticket. When the rate-sheet is completed and copies of it forwarded to the railroad commission, it is, indeed, a sensitive organization.

But no sooner will the cumbersome rate-sheet be completed, before some little road off in a distant corner of the country will send a printed announcement of some slight change in its passenger charges. In an instant, the whole mighty fabric of the rate-sheet must be torn apart and reconstructed. If the St. Louis Southwestern, by reason of a single change in the rates of the little Blissville, Bulgetown and Beyond (with which it connects) is enabled to charge a few cents less than the rival Transcontinental, its rate-sheet must be torn asunder and a new one adopted.

Beyond the long desks where the rate-clerks keep at their tedious jobs of constant readjustment of local and through rates, the passenger department has located its ticket re-

demption bureau. It announces publicly its willingness to redeem unused portions of its tickets, and the work of figuring out the amount due on a ticket, sometimes half or three-quarters used, requires a rate-clerk of ability and patience. The redemption clerk holds a ticket up to the light for your inspection.

"They tried to put this over on me," he says as he shows a local ticket which had been sent to him for redemption at full value. The pasteboard is filled with small burned holes. "The breezy young man who forwarded this exhibit to me claimed that he had used no portion of this ticket and then apologized to me for its condition. His small boy, he said, had burned it with Fourth-of-July punk.

"Punk? That was punk. The small boy did not do a thorough job. Every hole burned there was burned to hide a conductor's punchmark. You can see the edges of three of them; and those three punch marks show that the ticket issued from B—— to T—— was used 300 miles from B—— to A—— and not used from A—— to T——. When that young man threatened us with trouble on that ticket deal, we threatened him with arrest. After that he shut up."

So does the general passenger agent come in constant contact with the great American public. His outside mail is probably the largest at headquarters, and it contains letters of every sort, asking innumerable questions, praising and damning his road with equal interest and force. One letter will commend a courteous conductor, the next will find some fault with the dining-car service. It is not so very long ago that a big Eastern railroad sent out a general order that the raw oysters on its dining-cars should be served affixed to their shells, because a woman from Sioux City had written a positive assertion that the shells were being used over and over again for canned oysters.

Some of the railroads have already begun to systematize this whole matter of complaints. One New York

ity line which sells a large amount of transportation in nall packages every day (two million passengers is its verage in twenty-four hours) has a Harvard man at high alary just to receive those letters and give diplomatic answer to each of them. Each complaint is first acknowledged and then investigated; the person who made the complaint is notified of the final action taken. If a matter of fare is involved (the complicated transfer systems of New York make such questions frequent), and the company is wrong, it cheerfully acknowledges its fault and forwards car tickets as reimbursement. Many times when a conductor or a motorman has forgotten his manners, he is sent to make a personal apology to the aggrieved passenger, as a price of holding his position. That street railway company has won many friends out of persons who had complained to it, because of this method.

But here is the general passenger agent of a big steam road, who holds a considerably different view of this very matter.

"We never get in writing on one of these complaints," he says. "We send a man every time to make the matter right, and the man must be a diplomat. He must understand human nature, and so well does he understand it, that he makes the matter right in ninety-nine cases out of a hundred — turns an enemy into a friend, a liability into an asset, makes a firm patron for our road."

"Liabilities into assets!" That then is the work of the general passenger agent and his remarkable department. "Liabilities into assets!" In these days of cold judgments upon the managements of the big railroad properties, such a man is worth his weight in gold to a big system. He measures his worth in the assets that he brings to it.

CHAPTER XVIII

THE LUXURY OF MODERN RAILROAD TRAVEL

SPECIAL TRAINS PROVIDED — PRIVATE CARS — SPECIALS FOR ACTORS, ACTRESSES, AND MUSICIANS — CRUDE COACHES ON EARLY RAILROADS — LUXURIOUS OLD-TIME SLEEPING-CARS — PULLMAN'S SLEEPERS MADE AT FIRST FROM OLD COACHES — HIS PIONEER — THE FIRST DINING-CARS — THE PRESENT-DAY DINING-CARS — DINNERS, TABLE D' HÔTE AND A LA CARTE — CAFÉ-CARS — BUFFET-CARS — CARE FOR THE COMFORT OF WOMEN.

IF a man stops you in Nassau Street, New York, in the late afternoon, and you miss your favorite eighteen-hour train; if it is imperative that you be in Chicago the next morning at ten o'clock, and (this a most important "if") if you are willing to spend your money pretty freely, the railroad will accomplish it for you. If you are well known, and your credit accomplished with the railroad folks, it is highly probable that you will find your special, ready to accomplish an over-night run of nearly 1,000 miles, standing waiting in the train-shed when you hurry to the station. Even if your credit is not so established, the sight of several thousand dollars in greenbacks will accomplish the trick for you. The train will be ready in any event almost as soon as you.

If you are planning a novel outing, you may ring for a railroad representative and he will bring to your house or to your office tickets on any train and to any part of the world, or he will be prepared to arrange a special train for a night's run or for a three months' swing around the country. Your train may be of any length you desire and are willing to pay for. You can hire a car and it will be handled either as regular express trains or with special engines. You pay the bills and you have your choice.

A run in a private car is the acme of luxury to the average man. These are used for a variety of purposes in these comfort-loving days, and the sight of one or more of them attached to the rear of a heavy train has ceased to excite comment. The average luxury-loving millionaire has one — possibly two — of these expensive toys attached to an entourage that embraces ocean-going yachts, complete stables, and dozens of motor-cars of every description. If he can claim some sort of responsible connection with a large railroad system, he is likely to have his car hauled free from one ocean to the other; and the millionaire likes these little perquisites. He is not so far removed, after all, from the man who huddles in the corner of the smoking-car and secretly hopes and prays that the conductor will forget to collect his ticket.

To appreciate the number and variety of these cars take a look at the passenger sidings at any of the large Florida beach hotels in midwinter. Better still, run down to Princeton or up to New Haven at any large football game. You will see parked there at such a time from sixty to one hundred of these palatial cars, some of them private property, others chartered for the occasion.

Even in the middle of the night this branch of luxurious railroad traffic is still at your disposal. An emergency call summons you out of town for a distance, and the night train schedules do not meet your needs. The night train-master will meet your needs. He will act as the agent of the railroad and arrange, while you hold the telephone receiver in your fingers, the entire schedule for you. Trains will be held, connections made; the telegraph is capable of arranging the details. If you demand speed, the railroad will give it to you — if you are willing to pay the price and give a release against damage to your precious bones. Increased speed means increased risk to your railroader.

Maude Adams uses a special many Saturday nights to carry her down to her Long Island farm at Ronkonkoma.

Her place is far out of the regular suburban district, and there are no regular trains that will enable her to reach it after the evening performance. For ordinary service she is quite content with a private car — the mania has its deathly grip on a good many of our prosperous theatrical folk.

Lillian Russell used to live down in the Rockaway section of Long Island, hardly outside of the New York City limits. When she played in the metropolis a special train carried her six nights in the week out to her suburban home. There were plenty of regular trains — theatre trains, in the colloquialism of the railroaders — but the prima donna would have none of them. She had acquired the private-car mania while she was on the road. So her special stood night after night in the big railroad terminal in Long Island City — a neat little acquisition for a prosperous lady. The nightly ride cost her fifty dollars to the railroad company; and the generous tips she lavished, from the engine-cab back, doubled that sum.

Hardly a prosperous star, these days, but demands in the contract a fully-equipped car for the long, hard days on the road. The car has some value for advertising; its greatest value, however, lies in the maximum degree of comfort that it affords, as compared with the constant changing from one country hotel to another. Sometimes the biggest of these folk let the mania seize so tightly upon them that they go to excess.

Paderewski, on his first trip to America, made a flying journey up to Poughkeepsie to bewilder the fair Vassarites. He shuddered at the thought of what he was pleased to call the provinces. He had the popular European notion of American small towns and their hostelries. Poughkeepsie has very comfortable hotels, but Paderewski would not risk them. He would not sleep in them, neither would he eat in them. A private car solved the first of these problems; the second was met by bringing two cooks and a waiter up from the New

York hotel in which he was staying. He was paid $1,000 for the concert, and his travelling expenses cost him more than half that sum, which was a pretty good ratio.

Still, stage folk are not in the habit of counting either ratios or their pennies, and the average prima donna would make some sacrifices at the savings-bank in order to indulge herself in this extravagant and purely American mania. The grand-opera folk indulge themselves to the limit, invariably at the expense of the beneficent *impresario*. But even this long-suffering publicist does not feel the expense so bitterly. Special trains for opera companies make splendid advertising, but they do not cost one cent more than regular transportation. For the railroads, acting under the guidance of an all-wise and all-powerful commission down at Washington, will issue, without extra cost, from sixty to one hundred tickets for the man who orders a special train at two dollars a mile. In this way the wise theatrical manager keeps his little flock segregated while *en route*, and reaps gratuitously the prestige and the advertising that ensue.

Even the cheaper companies have their own cars — gaudy affairs most of them, their battered sides still reflecting the brilliancy of some gifted sign-painter. You must remember seeing them in the long ago, back there at the home-town, stuck in the long siding next the coal-shed, and surrounded by admiring youth, getting its first faint taint of the mania. The All-Star Imperial Minstrel Troupes, and the Uncle Tom shows, are the graveyards of the private cars. Proud equipages that in their days have housed real magnates and have been the theatres of what we like mysteriously to call "big deals," once supplanted, drop quickly down the scale of elegance. In their last days they come to the hard use of some itinerant band of entertainers, to squeak their rusty joints and worn frames as if in protest against a fly-by-night existence over jerkwater railroad branches.

Come back again to those cars you see at the college

football games, the travelling private palaces that migrate up to Newport, the White Mountains, and the Adirondacks in summer; that flock south in the winter like the birds. The astonishing thing is that few of these cars are owned by the persons who are using them. Of course, as we have already said, if a man can lay claim to some railroad connection, he can get his car hauled free over other lines and, perhaps, get it built for him; but more of that in a moment. There are probably not more than 40 private cars in the land that are owned by persons not connected with the railroads. This is an astonishingly low figure, considering the number of these craft that are constantly drifting about our 200,000 miles of track. Some society folk have cars as a part of their daily life, but the storage costs are apt to cause a man to think twice before he buys one. Mr. Rockefeller and Mr. Morgan have managed to worry along very comfortably without contracting the disease. As a rule, both of these men are willing to accept the comfort of any of the fast limited trains that form part of the luxurious equipment of the American railroad.

But the fact remains that the average citizen, when he is felled by an intermittent attack of the private-car mania, is content to hire one of the very comfortable equipages that the Pullman Company keeps ready at big terminals at various points across the country. The arrangements for these are exclusive of the price paid to the railroad companies for their haul. A complete private car, equipped with staterooms, baths, private dining-room, observation parlor and the like, costs seventy-five dollars a day. For two or more days this rate drops to fifty dollars a day. An extra charge is made for food; but the railroad will deliver the car without charge at the point from which you wish to begin your journey.

For the haul of these cars the railroads will charge you according to their regularly filed tariffs, unless you have *that* valued connection with some common carrier. This

CONNECTING DRAWING ROOM AND STATE ROOM

"A MAN MAY HAVE AS FINE A BED IN A SLEEPING CAR AS IN THE BEST HOTEL IN ALL THE LAND"

"YOU MAY HAVE THE MANICURE UPON THE MODERN TRAIN"

"THE DINING-CAR IS A SOCIABLE SORT OF PLACE"

varies from a minimum of from eighteen to twenty-five first-class fares. In other words, let us assume that the minimum in a particular case is twenty fares. That particular railroad will carry up to twenty persons in the car at its regular fares; if there are more than twenty aboard it will get a full fare ticket from each over the minimum allowance. That is all a matter established as the special train rates are established, not by whim, but by law.

Strange as it may seem, the private car mania, in chronic form, seems to attack some railroad presidents most violently. For reasons which show that railroading is a business filled with fine tact and diplomacy, these cars are called business cars. It is also remarkable that for size and elegance they vary in almost inverse ratio to the size and importance of the railroad that owns them. Big railroads, like the Pennsylvania, the Harriman lines, and the New York Central rather pride themselves upon the simplicity of their official cars. Some of these are plain almost to the point of shabbiness. Contrasted with these are the private cars belonging to the head of a great interurban electric line in Southern California, a car so wondrously beautiful that it was carried all the way to Washington, in the Spring of 1905, so that a thousand foreign railroad managers there gathered in convention, might see the attainments of American car-builders. Another Western railroad, a small steam line this time, boasts a president's car with a dining service that cost $2,500. A little Mississippi lumbering road spent $40,000 in providing a private car for its operating head.

The big Eastern roads know about all of these cars. Their heads get frequent invitations to take a run over the K., Y. & Z., or some other enterprising jerkwater road that runs from the back waters to the bad lands. Of course, they never take the trip, but they invariably see the next step in the developments. It comes in the form of requests for a "pass for haul of car and party"

from Chicago to New York and return. Time was when the New York Central and the Pennsylvania were laid low under the avalanche of requests of this sort. Some of their slower trains were laden down with long strings of these deadhead caravans, and on one memorable occasion a whole section was made up of the prominent private cars of decidedly unprominent railroad officers.

Since the introduction of the eighteen-hour trains between these two most important cities of the country this burden has been lessened. These fastest trains will absolutely not haul any private cars at any price; it is a rule that would not be abrogated for the President of the United States. So the railroaders of the West, from the big men like Stubbs and Kruttschnitt of the Union Pacific down to the small fry, leave their cars in the roomy terminal yards at Chicago and come to New York most of the time on one or the other of the eighteen-hour trains. About the only time their cars come East nowadays is when they are bringing their families to the seashore for the Summer.

So much for the private cars. They are perhaps one of the most typical things of the America of to-day, as we have seen. Actresses and millionaires use them for their private comfort and convenience; tourist parties roam forth in them; delegations proceed in them to conventions; civic bodies find them agreeable aids to junketing. Sometimes a party of sportsmen will charter a car and hie themselves off to a secluded spot where the railroad roams through the forest, find an idle siding and use their car for a camp for a week, a fortnight, or even a month. Cities and States use private cars as travelling museums to exploit their charms, some of them are travelling chapels for religious propagandism. The uses of the private car are nearly as manifold as those of the railroad itself.

In the beginning things were different. Our great grand-daddies drew no class lines when they travelled, but

were content to find shelter from the storm, or upon pleasant days from the showers of sparks scattered by the locomotive. But when the railroad began to stretch itself and to be a thing of reaches, it was found advisable to run trains at night in order to make quick communication between distant points. Travelling at night in the crude coaches of the early railroads was an abominable thing, and before the forties the old Cumberland Valley Railroad was operating some crude sort of sleeping-cars. Within another decade there was much experimenting of this sort. Old-timers on the Erie still remember the sleeping-cars that were built on that road soon after the close of the Civil War. There were six of them, more like summer cottages than cars, for the Erie was then of 6-foot gauge, and its cars were 12 feet wide. The berths were made up in crude form by hanging curtains from iron rods and bringing the bedding from a storage closet at the end of the car. There was a little less privacy in them than in the modern Pullman, but in the eyes of Jim Fisk, whose love of elegant luxury was first responsible for their construction, they were nothing less than palaces. One of them was named after Fisk and carried his portrait in an immense decorative medallion on each of its sides. The other cars were the *Jay Gould* — without decorative medallions — the *Morning Star,* the *Evening Star,* the *Queen City,* and the *Crescent City.* All you have to do to-day, to set an old Erie man's tongue wagging, is to speak of one of these cars. They were triumphs, and away back in that day and generation they cost $60,000 each.

But while many men were fussing in futile ways to build comfortable cars for long journeys, a man named George M. Pullman, over in Western New York, was packing his goods and making ready to go to Chicago and build his world-famed car-works there. Pullman's cars survived the others. He bought in the Woodruff Company and some lesser concerns, and for many years his

only important rival was the Wagner Palace Car Company, a Vanderbilt property. In course of time this too was absorbed, and the Pullman Company had virtual control of the luxurious part of American traffic, few railroads caring to run their own parlor and sleeping-car service.

There are economic and sensible reasons for this in many cases. Some railroads have great through passenger traffic, demanding Pullman equipment in summer and little or none in winter. Others reverse this need and so whole trains of sleeping and parlor cars go flocking north and south and then north again with the private cars. Special occasions, like great conventions, call for extra Pullmans by hundreds; and because of the enormous capital that must be tied up, a single supplying company is best able to handle the problem. Still, big roads like the New Haven, the Milwaukee, and the Great Northern have been most successful in building and operating their own sleeping and parlor-car service. A great road like the Pennsylvania might do the same thing, and because of that possibility the Pennsylvania was one of the first roads in the country to make the Pullman Company pay it for the privilege of hauling its cars. As a rule, the railroad pays the Pullman Company for hauling by the mile — a very few cents a mile — and the Pullman Company also takes the entire receipts to itself.

The body of Abraham Lincoln was carried to its final resting-place in the first real Pullman car that was ever built. President Lincoln rode in one of Pullman's earliest attempts at railroad luxury, some sleeping-cars that he had remodelled from day coaches on the Chicago & Alton Railroad and that were put in service between Chicago and St. Louis in 1860. These cars were almost as crude as the barbaric predecessors that had induced Pullman to tackle the problem of railroad comfort approaching the standards of boat comfort.

Leonard Seibert, a veteran employee of the Chicago & Alton, told a few years ago of Mr. Pullman's first attempts to remodel the old coaches of that road into sleeping-cars. Said he:

"In 1858 Mr. Pullman came to Bloomington and engaged me to do the work of remodelling the Chicago & Alton coaches into the first Pullman sleeping-cars. The contract was that Mr. Pullman should make all necessary changes inside of the cars. After looking over the entire passenger car equipment of the road, which at that time constituted about a dozen cars, we selected Coaches Nos. 9 and 19. They were 44 feet long, had flat roofs like box cars, single sash windows, of which there were fourteen on a side, the glass in each sash being only a little over one foot square. The roof was only a trifle over six feet from the floor of the car. Into this car we got ten sleeping-car sections, besides a linen locker and two washrooms — one at each end.

"The wood used in the interior finish was cherry. Mr. Pullman was anxious to get hickory, to stand the hard usage which it was supposed the cars would receive. I worked part of the Summer of 1858, employing an assistant or two, and the cars went into service in the Fall of 1858. There were no blue prints or plans made for the remodelling of these first two sleeping-cars, and Mr. Pullman and I worked out the details and measurements as we came to them. The two cars cost Mr. Pullman not more than $2,000, or $1,000 each. They were upholstered in plush, lighted by oil lamps, heated with box stoves, and mounted on four-wheel trucks with iron wheels. The berth rate was fifty cents a night. There was no porter in those days; the brakeman made up the beds."

Pullman built his first real sleeping-car in 1864. It was called the *Pioneer* and he further designated it by the letter "A," not dreaming that there would ever be enough Pullman cars to exhaust the letters of the alpha-

bet. The *Pioneer* was built in a Chicago & Alton car shop, and it cost the almost fabulous, in those times, sum of $18,000. That was extravagant car-building in a year when the best of railroad coaches could be built at a cost not exceeding $4,500 each. But the *Pioneer* was blazing a new path in luxury. From without, it was radiant in paints and varnishes, in gay stripings and letterings; it was a giant compared with its fellows, for it was a foot wider and two and a half feet higher than any car ever built before. It had the hinged berths that are to-day the distinctive feature of the American sleeping car, and the porter and the passengers no longer had to drag the bedding from closets at the far end of the car.

The *Pioneer* was not only wider and higher than other passenger cars, it was also wider and higher than the clearances of station platforms and overhead bridges. But when the country was reduced to the deepest distress because of the death of President Lincoln, the fame of Pullman's *Pioneer* was already widespread, and it was suggested that the fine new car should be the funeral coach of the martyred president. This involved cutting wider clearances all the way from Washington by the way of Philadelphia, New York, and Albany to Springfield, Ill.; and gangs of men worked night and day making the needed changes. Pullman knew that the increased convenience of an attractive car built upon proper proportions would justify these changes in the long run, and it is significant that the height and width of the Pullman cars to-day are those of the *Pioneer;* the changes have been made in the length. Not long after that car had carried President Lincoln to his grave, General Grant started on a trip west, and the Michigan Central Railroad anxious to carry him over its lines from Detroit to Chicago, widened its clearances for the same celebrated car. After that there were several paths open for the big car, and work was begun upon its fellows. It went

AN INTERIOR VIEW OF ONE OF THE EARLIEST PULLMAN SLEEPING-CARS

INTERIOR OF A STANDARD SLEEPING-CAR
OF TO-DAY

o regular service on the Chicago & Alton Railroad; d the Pullman Palace Car Company was formed in 67. The alphabet soon ran out, and the company to-y operates between four and five thousand cars in reg-ır service. There is a popular tradition, several times nied, to the effect that Pullman for many years gave ; daughters $100 each for the names of the cars, and at that formed the source of their pin money.

While the dimensions of the car were largely set, im-ovements in its construction have gone steadily forward, has been told in an earlier chapter. The interior of ese luxurious modern cars has not been neglected. om the beginning they have been elaborate in rare oods and splendid textile fittings. The advancing era of nerican good taste has done much toward softening the er-elaboration of car interiors — the sort of sleeping r that George Ade used to call "the chambermaid's eam of heaven." The newest cars present the quiet gance and good taste of a modern residence. Nothing at may be added in wealth of material or of comfort omitted, but the foolish draperies and carvings that once ıde the American car the laughing-stock of Europeans ve already gone their way.

To make for luxury all manner of devices have been ded to these cars. The superintendent sometimes hears mplaints from a traveller that the sharp curves on some ountain division have spilled the water on his bath-tub; d the switching-crews at the big terminals know that rntables are kept busy turning the big observation plat-rm cars so that they will "set right," and the big azza-like platform will rest squarely at the rear of the ain. For those persons who wish to pay for the luxury ere are staterooms, and the best of these staterooms ve the baths and big comfortable brass beds. After any years of unsatisfactory experiment the electric light s come into its own upon the railroad train; and even

upon unpretentious trains the night traveller no longer has to wrestle with the difficulties of dressing or undressing in an absolutely dark berth.

Once the problem of housing folk at night had been met and solved, another rose. If travellers might sleep upon a train, why might they not eat there, too? The American eating-houses had met with a degree of fame. There are old fellows who will still tell you of the glories of the dining-rooms at Springfield, at Poughkeepsie, at Hornellsville, and at Altoona. But the eating-house scheme had its great disadvantages. For one thing, it caused a delay in the progress of through fast trains to halt them three times a day while the passengers piled out of the cars and went across to some lunch-counter or dining-room to ruin their digestions in the twenty minutes allotted for each meal. For another thing, the process of clambering in and out of the comfortable train in all sorts of weather was unpopular. The well-established and equally well-famed eating-houses along the trunk-line railroads were doomed from the time that the *Pioneer* won its first success.

No more should a train tie up at meal-time than a steamboat should tie up at her wharf for a similar purpose. The first dining-cars were called hotel-cars; and the first of these, the *President*, was placed in operation by the Pullman company on the Great Western Railway — now the Grand Trunk — of Canada, in 1867. The hotel-car was nothing more or less than a sleeping-car with a kitchen built in at one end and facilities for serving meals at tables placed at the berths. It was well enough in its way, but travellers demanded something better, something more hygienic than eating meals in a sleeping place.

Pullman went hard at his problem, and in another year he had evolved the first real dining-car, the *Delmonico*, which went into regular service on the Chicago & Alton Railway. The Delmonico was a pretty complete sort of

a restaurant on wheels, and not far different from the dining-car of to-day.

To-day there are 750 successors to the old *Delmonico* in daily service on the railroads of the United States. A small regiment of men earn their livelihood upon them; some genius, handy with a lead pencil, has estimated that these serve some 60,000 meals — breakfast, lunch, and dinner — every day. The amount of food and drink consumed is a matter that is left to the statistician.

The average full-sized dining-car seats 40 persons, but that does not represent the business it does. Unless the car can be completely filled two or more times at each meal, it is not considered a profitable run. The European method of reserving seats at "first table" or "second table" has never obtained in the United States, and the wise man on a popular train sacrifices his dignity and hurries toward the dining-car at the first intimation that the meal is ready.

To take care of the hungry folk a dining-car crew of nine men is kept busy. The car is in absolute charge of a conductor or steward, who is held sharply accountable by the dining-car superintendent of the road for the conduct of his men and of his car. He signs a receipt for the car equipment before starting on his run out over the line, and he must see to it that none of that equipment, not a single napkin or spoon out of all his stock, is missing at its end. He is held in as strict account for the appearance and behavior of his men. The waiters must be neatly dressed, must have clean linen; the conductor himself must be something of a Beau Brummel, carrying a certain polite smile toward each one of the road's patrons, no matter how disagreeable or cranky he or she may be. For all of these things and many others — maintaining a sharp guard over the car's miniature wine-cellars, adding "specials" to the bill-of-fare for a given day, acting as a cashier for the service — he receives a princely salary, varying from $75 to $110 a month.

His crew, as far as the passengers see it, consists of five men, almost always negroes. Back in the tiny kitchen is the chef, with two assistants, preparing the food. The kitchen is tiny. It is less than five feet wide and fifteen feet long, and the three men who work within it must have a place for everything in it, including themselves. Obviously there is no room for the waiters, and these receive their supplies through a small wicket window.

If the kitchen is tiny, it is also marvellously complete. An ice-box fits upon and takes half the space of the wide vestibule platform; the range has the compact dimensions of a yacht's range; sinks, pots, and kettles fit into inconceivably small spaces. Yet in these tiny cubbyholes one hundred, ofttimes many more dinners, of seven or eight courses each, are carefully prepared, with a skill in the cooking that is a marvel to restaurateurs.

The *table d'hôte* dinner — the famous "dollar dinner" — of the American railroad has almost disappeared. The constant increase in foodstuffs is most largely responsible for this. The Pullman Company long ago gave up this particular feature of passenger luxury, save in a few isolated cases. It had ceased to be a particularly profitable business, this serving of fine meals for a dollar each; and so the railroads themselves took it up and prepared to make it a cost business for the advertising value to them. Each railroad plumed itself upon its dining-car service — some of them still do — and each was willing to lose a little money, perhaps, to induce travel to come its way because of the superior meals it served upon its trains. But as the price of food-stuffs continued steadily to rise, the advertising feature of these meals began to be more and more expensive, and the dollar dinner quickly disappeared. A high priced *à-la-carte* service took its place, and the railroads sought to establish their commissary upon a money-making basis.

The attempt has not been very successful. For the lifting of the dining-car prices and the attempt to reduce

running expenses has, on some roads in particular, hurt the reputation of these "restaurants on wheels," and so in due season hurt their patronage; brought their patrons from folk who went out of their way to eat on dining-cars to folk who eat there only because of dire necessity. And these last still have found prices high and the result is to be eventually a return to former methods in part — slower trains stopping again for meals at important stations, the faster trains returning to the *table d'hôte*. Beginnings have been made along that line recently. The dollar dinner may never return to some roads — although it remains a joy and a delight to travellers upon the New Haven system — but the "regular dinner" at least, capable of quick service in a crowded car, bids fair to have a renaissance.

While the problem of dining-car economy, and profit even, remains a problem, the idea is nevertheless being steadily extended all the while to branches and to trains that could not support full-sized dining-cars. To meet these needs smaller cars — generally called *café*-cars — in which the dining-compartment is much reduced in size, have been built and operated. In these two cooks, two waiters and a steward form the working force and the fixed charges of the outfit are correspondingly reduced. They are further reduced in the operation of the so-called broiler-coach, which is nothing more or less than a day-car with a kitchen built in, the entire service being performed by one or two cooks and a like number of waiters. Some sleeping-cars and some parlor cars still have kitchens where a single accomplished negro may act as both cook and waiter, and these cars are designated commonly as buffet sleepers or buffet parlor cars.

The dining-car department of the railroad will probably have more to do than supervise the operation of these various sorts of equipment. Restaurants and lunch-rooms at terminals and stations along the line may fall under its direct supervision, and it will probably also

conduct the cuisine of the private cars of the railroad's officers.

The dining-car department has direct charge of all the men employed on cars and in the lunch-rooms; it sees to it that the railroad's culinary equipment is fully maintained; it buys food and drink, linen, silver, china, kitchen supplies of every sort. The routing of the cars is carefully planned to secure the most economical use of them. Few trains running from New York to Chicago will carry a single diner throughout the entire trip. These trains will use two, sometimes three cars during a single-way trip between the cities. A single car will generally make the daylight run with the train, to be dropped at night to continue its course west again at daylight upon some other train needing meal service. The first train will pick up a fresh diner in the morning to carry into Chicago. In this way, a diner may take a week or more to make the round trip from New York to Chicago. Obviously, her commissary must meet all needs along the way. Staple supplies, liquors, dry groceries are all placed aboard the car at the terminals. Fresh meats and vegetables are picked up along the route. This town has an especial reputation for its chickens; this for its grapes; this other for its celery. The dining-car department knows all these, and it selects under the rare opportunity of a housewife who has a market nearly a thousand miles long within which to do her marketing.

Just as the glorious comfort of the American river steamboat of the fifties was responsible for the plans for eating and sleeping aboard the railroad trains, so it was responsible for the introduction of a finer luxury in railroad travel, until to-day, when the resources of the general passenger agent are taxed to discover some new ingenious joy to add to the pleasure of going by this particular line. The full development of the protected vestibule platform and the opportunity it afforded of easy

intercourse between the coaches of a train led to many new devices to make the long cross-country trip of the traveller more than ever a thing of joy. First came the buffet-car, with all the conveniences of a man's club; and the car-builders have shown remarkable ingenuity in imitating the mission-like grillroom interiors, despite the many limitations placed upon them. No club was complete without a barber-shop, and soon every fast-rushing limited of any consequence had a dusky servitor whose sharp-bladed razor was warranted not to cut even when the train struck a sharp curve at fifty miles an hour. Stationery, books, and magazines became features of the buffet-car. After that there came a stenographer, whose services were free to the patrons of the train.

Most of these things were for the comfort of men, who form the majority of patrons of the railroad. But a considerable portion of femininity travels, and it sent in a complaint that its comfort was being neglected. The general passenger agents gave quick ear. The men's buffet, with its comfortable adjuncts of smoke and drink was at the forward end of the train, the women were considered in the big, comfortable observation cars at the rear. They were given more stationery, more magazines, even a caseful of books, running from the severe standard works to the gayest and lightest of modern fiction. Ladies' maids were installed upon the trains, and the girl running from New York up to Albany could have her nails manicured while upon the train.

These are all details, but each goes to make the comfort of the traveller upon the American railroad train. Such comfort is not equalled in any other country in the world. From the moment he steps from his cab, the American traveller passing through the magnificence of superb waiting-rooms enters palatial trains, superior to the private trains of royalty upon the other side of the ocean. A corps of well-trained *attachés* look to his comfort and his ease, every moment that he is upon the train,

whether his ride be of an hour's duration or a four-days' run across the continent. Other railroaders whom he does not see, engine crews, changing each few hours upon his run, signalmen in the towers along the route, telegraphers, despatchers, train walkers, car inspectors help in their small but important ways to make his trip one of comfort and of safety. The entire organization of the railroad lends itself to that very purpose.

The railroad does not stop at the mere exercise of its great function as a carrier; it does not even stop with the exercise of its every ingenuity toward safety in its transportation; it goes a little further and gives to the man or woman who rides upon its rails, a degree of luxurious comfort equal to if not even greater than that man or woman can receive at any other place.

CHAPTER XIX

THE CITY OUT INTO THE COUNTRY

NS IN MANY TOWNS — RAPID INCREASE IN THE VOL-AN TRAVEL — ELECTRIFICATION OF THE LINES — LONG ID ALMOST EXCLUSIVELY SUBURBAN — VARIED DIS-URBAN HOMES FROM THE CITIES — CLUB-CARS FOR TATEROOMS IN THE SUBURBAN CARS — SPECIAL TRANS-

he Commuter slams his desk shut at the f a busy day, he is fully aware that he is a Other mortals condemned to hard labor y squeeze within the ill-ventilated confines elevated or subway train, may find their apartments, which, if their fronts were to moved, would look for all the world like k tier upon tier in a shop. The Commuter chest. Not for him. His is a different feels justified in thinking that his is the ere is nothing narrow about the Commuter; h of the country has tended to widen him. way to the showy railroad terminal, down oncourse with a human stream of other the 5:37. That train is part of his reg- of life. It has been such ever since he the country, a dozen years ago. If the er be stricken from the time-card the Com- eel as if the light had been extinguished. me meddler violently assumed to change it ıe Commuter was one of a committee who fied general passenger agent and had the set right again. There is only one other ıst approach the 5:37 in regularity; that is

the 7:52, on which the Commuter slinks sorrowfully into the dirty town each morning. Other trains may be jumped about on the time-card, the Commuter is oblivious of their fate. But let his 7:52 be ten minutes late into the big terminal three mornings in succession, and the Commuter begins to write letters to the papers and to the officers of the railroad.

Once aboard the 5:37 the Commuter trails his way into the smoker. Jim, the brakeman, who is the source of all trustworthy information about the railroad, and who can even foreshadow the resignation of the president, has stored away the table and the cards. They are produced for the daily consideration of a dime and a game that runs week in and week out is ready to begin. Smith, of the Standard Oil crowd, drops into his seat; Higgins, the lawyer, into his; the others are quickly filled; packages — foodstuffs from the cheaper city markets and hurried purchases made at noon from handy shops — go into the racks, and the Commuter is oblivious until, as if by instinct, a familiar red barn goes flying backwards. The game is off again until to-morrow morning; he is sorting his own packages out of the rack. The train halts for a single nervous moment, and he is on the platform. The cars roll past him; the party are at a three-handed game now.

The Commuter finds his way up a steep road to his home on the hillside, his very own home. It looks as sweet, set in there among the bushes and the trees, as it did the day he bought it; and that day it looked to him as Paradise. When night comes, there comes a peace and quiet, a peculiar country coolness in the air. The city is steaming from the hot day, and through the night the pavements and the roofs still emit heat. The Commuter has forgotten the city. He sleeps as he slept as a boy on a farm, where a city was but a hazy dream in his mind. When he awakes he is refreshed, invigorated. The country has repaid him for the trouble that he has

taken to reach it. He goes into town again on that blessed 7:52, twice as good a workingman as the man who has the next desk to his, the poor chap who had to sit on the apartment steps until after midnight in order to get even a miserable degree of comfort.

That is why the city goes out into the country.

The Commuter is apt to settle his thoughts upon himself, to forget that he is but an infinitely small part of a mighty home-going army that nightly calls all the passenger resources of the railroad into play. There are more than 100,000 of him alone in the metropolitan district around New York. The busy Long Island Railroad takes a host of him nightly off to the garden spots of that wonderful land from which it takes its name; the Central Railroad reaches off into the lowlands, and the Erie and the Lackawanna into the highlands of New Jersey; the New York Central and the New Haven tap the picturesque shores of the Hudson and the Sound.

Boston repeats New York in this human tide that ebbs and flows daily through her gates. From both her North and South stations mighty armies of Commuters come and go until one wonders sometimes if any one really lives in Boston itself. There are more than 60,000 of this army at the Hub. In Philadelphia, the Pennsylvania and the Reading handle from their terminals an army of equal size each night; another finds its way from the smoky, dirty heart of Pittsburgh out into the attractive towns that perch the hills in her vicinage.

Middle West cities, even those of good size, differ from Eastern in the fact that they are rarely hampered in their growth by natural conditions. In big towns like Cleveland and Detroit, for instance, the natural and the artificial electric transit facilities are so good as to bring the commutation business to a minimum. Not so with Chicago. The Illinois Central from the south, the Northwestern and the St. Paul from the north, serve

rapidly growing suburban areas that will compare with some of the best in the East. Then, after the Commuters in the East are safely home, another army is finding its way across the bay, and off to the north and the south of San Francisco. These are the big centres of commuting as the American railroads know it. In smaller measure it exists at every large city in the country. The familiar monthly card ticket, representing its cousin, that holy-of-holies — the annual pass, is issued from good-sized villages and pretentious country seats. The Commuter is already a national institution.

Conductor John M. Dorsey, who used to run an Erie train out of Jersey City in the long ago, once showed us what he thought was the first example of a pure commutation business. It was a list issued to Erie conductors in 1860, and containing the names of 162 persons who travelled daily in and out of New York by the way of Jersey City. These folk lived in Passaic (they called it Boiling Springs in those days), and in Paterson, and all the way up the line to Goshen and Middletown. When a man wanted to commute then he paid a monthly fee to the railroad and they printed his name on this official list. Such a scheme would be obviously out of the question these days.

When New York refused to stop growing, and more and more people began making the daily trip in and out of Jersey City, the handy method of the commutation ticket was substituted for the cumbersome printed list, and the Erie and all the other railroads began to cater to the Commuter with special short-distance trains. Committees came to railroad officers from various small towns and aided them in fixing a definite basis of fare, which remains to-day at something between six-tenths and three-quarters of a cent a mile. In later years, the real estate business became the science that it is to-day, and the suburban business began to move forward in long leaps.

"EVEN IN WINTER THERE IS A HOMELY, HOMEY AIR ABOUT THE COMMUTER'S STATION"

ENTRANCE TO THE GREAT FOUR-TRACK OPEN CUT WHICH THE ERIE HAS BUILT FOR THE COMMUTER'S COMFORT AT JERSEY CITY

A MODEL WAY-STATION ON THE LINES OF THE BOSTON & ALBANY RAILROAD

THE YARDMASTER'S OFFICE — IN AN ABANDONED SWITCH-TOWER

"It seems incredible," said a railroad officer just the other day, "but this suburban problem is all but overwhelming for us. It does not increase our revenues at so wonderful a pace, but it does increase in volume from 20 to 25 per cent a year; and think how that keeps us hustling, making facilities for it. There is not a railroad entering New York to-day that could not dismiss its passenger terminal problems to-morrow, if it were not for the Commuter. There is not a railroad coming into New York that could not handle all its through business in a train-house of from four to five tracks. Instead of that, what do we see? The Erie with five through trains requiring a terminal of sixteen tracks; the Lackawanna, with the same number of through trains, a new terminal of even greater size, the overwhelming passenger terminal problem being repeated at every corner of New York, just because of the tremendous annual increase in the suburban passenger business."

The great reconstruction of the Grand Central terminal facilities in the heart of New York, and the erection of a new station there, as described in detail in an earlier chapter, is directly due to the Commuter. When the new station with its double tier of tracks is finished, there will be thirty-two platform tracks in the double train-house, an amount far in excess of that needed for even the great volume of through business that goes and comes over the lines of the New York Central and the New York, New Haven, & Hartford, the two systems that use it. And the new station, involving a tremendous expenditure of money, of brains, and of energy, is not all.

The New Haven has electrified its four-track main line all the way out to Stamford, Conn., in order that it may in some measure cope with this increasing flow of suburban traffic over its already crowded main-line tracks. It has wrestled with the unanticipated problems of electrification because it has been facing a situation that left it no time to experiment elsewhere and approach its main-

line problem with deliberation. More and more folk were settling in the suburban towns in its territory each month, and deliberation was quite out of their calculations. The Commuter is rarely deliberate.

So the New Haven, with all the resources of a giant carrier, has found each new measure of relief swallowed up in the new flood and has turned to more radical methods. It has been apparent to its managers for some time past that even the new Grand Central, with its wonderful capacity, would some day prove inadequate, for the reason that the New York Central — the actual owners of the property — was also trying to cope with its own great increase in suburban traffic, and would eventually require more and more space for its own Commuters. With such a possibility in the future — not a distant future with the suburban business doubling in volume every four or five years — the New Haven sought to develop an unimportant freight branch leading from New Rochelle down to the Harlem River. It has almost finished the work of transforming this into a great electric carrier, six tracks in width. Railroad engineers show no hesitancy in saying that eight-track trunks will be needed out of New York in every direction within a dozen years. The Harlem River branch of the New Haven, once it is provided with a suitable terminal, will become a great artery of suburban traffic. It will give trunk capacity to make possible the development of a great new area lying just inland from the Sound, and yet within from 40 to 50 miles of New York City.

A third project in which New Haven capital is known to be interested is that of a high-speed, four-track suburban electric railroad also to reach into the Sound territory as far as Port Chester, with an important branch, diverging to White Plains, the shire-town of Westchester County. This line will feed into the main line of the New York subway, and so avoid cramping the terminals still further.

The terminals are the crux of the whole great problem of handling suburban traffic.

The New York Central has also electrified its tracks for a zone of some 40 to 50 miles from its terminal. This work was started primarily by a distressing accident in its old smoke-filled tunnel, that ran the length of Park Avenue under Manhattan Island, but New York Central officers are to-day free to admit that the electrification was close at hand in any event. The operation of a terminal so closely planned as the new Grand Central, with its train-sheds and yards built in layers, would have been a physical impossibility with smoky, dirty, steam locomotives.

The New York Central has been, as we shall see in greater detail in the chapter on the coming of electricity, the first of the standard steam railroads entering New York to provide suburban trains of multiple unit motor-cars, similar to those used in rapid transit subway and elevated trains. The great advantage of these trains over trains handled by either steam or electric locomotives is an operating advantage. The train may be so quickly turned in terminals as to bring the terminal problem down an appreciable percentage, and so to give a greater hauling capacity to main-line tracks. The Central, wedged in tightly by the high hills that lie to the north of the metropolis, has had to pin its faith to plans that utilize the present tracks to the uttermost capacity.

The railroads crossing New Jersey and reaching the west bank of the Hudson have not been behind the routes that enter from the north in providing for the suburban business. The recently opened McAdoo Tunnel, linking the Jersey terminals of the Erie, the Lackawanna, and the Pennsylvania with both the downtown and the uptown theatre, hotel, and shopping district of Manhattan, has been a great stimulus to the suburban development across the Hudson.

The Lackawanna has done its part by boring a second

tunnel under the Bergen Hill, parallel to its original tube, giving a four-track entrance to its fine new terminal, and relieving the congestion of suburban traffic night and morning at its worst point, the neck of the bottle. The Erie has already completed, as a part of its extensive terminal reconstruction-work in Jersey City, a similar project, a four-track open cut through the stout backbone of Bergen Hill. The open cut replaces completely the so-called Bergen Tunnel, which has already become a matter of history.

We have already told of the Pennsylvania terminal in New York. The Pennsylvania built the new station for through travel rather than for the Commuter, at the outset. But the Pennsylvania, with the exception of a brisk traffic out to Newark, is hardly a big suburban road, in the New York metropolitan district. The great volume of Commuters who will flock to its station nightly, will be bound east, not west. The Long Island Railroad, its property stretching less than one hundred miles east from New York, through what is one of the most attractive residential localities in the world, is almost exclusively a suburban system. Long Island is not a manufacturing or agricultural territory of consequence. There is not a town of 10,000 souls east of the New York City line. Freight traffic and through traffic, aside from some summer excursion business, is conspicuous by its absence. Yet the Long Island operates through its local station at Jamaica (an even dozen miles distant from the new Pennsylvania terminal), more than 800 trains a day. That, of itself, represents a volume of traffic, and speaks wonders for the desirability of the broad and sandy island as an escape from the city to the country.

"We have from 18,000 to 20,000 Commuters all the year round," said a Long Island official, just the other day; "and this branch of our traffic — our chief stronghold — is increasing at the rate of 25 per cent annually. We are trying to increase our facilities to keep pace with

the demand made upon them; that is why we became tenants in the new Pennsylvania Station. For our share of that work we will pay $65,000,000 — some money. But we cut twenty minutes off every Commuter's trip in each direction every day, and that is worth while in a day when every road is reaching out for new business. We do not consider that $65,000,000 to save a man forty minutes a day is money ill-spent; but I am frank in saying that we also expect our 25 per cent annual increase to remain for several years in order to make good such an expenditure."

Part of that $65,000,000 is yet to be spent on the electrification of the Long Island suburban lines, within a zone of from 30 to 40 miles out from the new terminal. The through trains running to the far eastern points of the island will run direct from the Pennsylvania Station as far as Jamaica by electricity, heavy motors hauling the standard equipment. At Jamaica, in a million-dollar transfer station that is part of the big improvement scheme, the steam locomotives will take up their part of the work. Electricity for long stretches of standard railroad where the traffic is comparatively slight is still an economic impossibility.

So much for New York, where the lead has been taken in providing suburban service on the railroads operated by electricity. The problem is being approached in Boston — who, like her larger sister, refuses to stay "put." South Station and North Station, on opposite sides of the city, are of the largest size, but they are beginning to feel the strain of traffic, which forges ahead every year. The Metropolitan Improvements Commission of that city has already made a careful study of the problem. It plans to relieve the situation by constructing a four-track tunnel from one station to the other, and operating both of them — as far as suburban traffic is concerned — as through stations rather than as terminals. In a word, Boston & Maine local trains entering North Station would not end

their runs there as at present, but would continue through the proposed tunnel to a second stop at South Station, where they would become outgoing New York, New Haven, & Hartford suburban locals. The same operation would be continued in a reverse direction. A more complicated adaptation of the scheme from a construction standpoint would still use the connecting tunnel and provide car-yards for the Boston & Maine trains outside of South Station, with a similar yard for the New Haven locals just beyond North Station. The main gain made by such a plan is the elimination of switching — the same point at which the New York Central and the Long Island have aimed in making their suburban trains of multiple units. With the hauling in and out of empty trains to and from a terminal eliminated, the capacity may be almost doubled. Another gain is the convenience to passengers who under such a plan would be enabled to reach either side of the city without changing cars, and a recourse to street transit facilities. The Boston plan, of course, embodies a change from steam to electricity as a motive power. It is one of the most comprehensive plans yet submitted for the solving of the great problem of getting the city out into the country.

In Philadelphia, they are feeling the pressure of the Commuter at both the big downtown terminals, the Pennsylvania and the Reading, while the first of these roads is already planning to electrify its suburban lines and to give Broad Street Station exclusively to this class of traffic. Philadelphia is such a wide-spreading and sprawling town that the trolley lines have afforded little real rapid transit to the outlying sections, while relief by subways and elevated lines has so far been meagre. As a result, a great burden of interurban as well as suburban traffic has been laid upon the railroads there, and they have been compelled repeatedly to enlarge both track and station facilities.

The Illinois Central, carrying a heavy traffic south of

Chicago, has prepared plans for the electrification of 325 miles of its suburban lines, and radical enlargement of terminal facilities. The Illinois Central has been very progressive in its methods of handling the Commuter traffic. Its side-door cars, permitting quick loading and unloading, have long marked a progressive step in equipment. The Chicago and Northwestern, in its splendid new white marble terminal on the West Side of Chicago, will give its chief use toward the upbuilding of a suburban traffic, already strong and well developed.

The Commuter covers a varied zone. His station may be less than a mile from the terminal and his home still within the crowded confines of the town, or he may be the last passenger of the train as it reaches the far end of its suburban run. The average commutation district runs about 30 miles out, with by far the heavier part of the traffic in the first 15 miles of this. Most of the railroads that cluster in at New York, however, issue commutation tickets out over a 70 or 80-mile radius. One man for many years held the record as a long-distance Commuter. He preferred to sleep nights within the quiet confines of Philadelphia and his 90-mile trip to New York, with a 90-mile return at the end of every day became a mere incident in his life. His record was beaten this year. A man arrives and departs from the Grand Central Station five days out of the week, who travels 320 miles on every one of them. He catches a fast train from his home town at seven o'clock in the morning, breakfasts on the train, and is at his New York office at 11:30 o'clock. He leaves his desk at 3:30 o'clock, dines on the returning express, and is home by eight. His daily trip, with all incidental expenses, aggregates more than $12.00; so he deserves to rank as the Champion Commuter.

If few Commuters can approach the mileage record of this man there are many who do not hesitate at extra expenditures for their comfort. About all of the best suburban expresses that come into New York carry some sort of

club or private-parlor cars. The club car is one of the most elaborate developments of the entire Commuter idea. It is a comfortable coach, which is rented to a group of responsible men coming either from a single point or a chain of contiguous points. The railroad charges from $250 to $300 a month for the use of this car in addition to the commutation fares, and the "club" arranges dues to cover this cost and the cost of such attendants and supplies as it may elect to place on its roving house. It must guarantee a certain number of riders to the railroad every trip, so the membership of the "club" is kept high enough to allow for a reasonable percentage failing to use the car daily. Some railroads go at the thing in another way. They supply the car and its attendants and make a monthly extra charge, in addition to commutation. The car is entirely filled with regular riders, so it is in a sense a club car.

Such a car has been running for some years on one of the suburban trains of the Harlem road. It is unique in some ways, and in these an outgrowth of early customs. The first of these began years ago, when the Oldest Commuter began his habit of riding to and from town in the baggage-car. There is something about a baggage-car that fascinates the ordinary man traveller. Perhaps it is the solemn rule of the railroad that attempts to prevent him from riding in this form of conveyance. At any rate in this particular case the Oldest Commuter gradually picks up an acquaintance with the baggageman; and, presuming upon that acquaintance gradually appropriates the baggageman's old chair for his own use. The baggageman was good-natured, for the Oldest Commuter was a generous fellow and never forgot Christmas-times and the like. He got another old chair from somewhere, and all was well until the Next Oldest Commuter absorbed the baggageman's chair, and the baggageman had to bring a third into his car. The Next to the Next Oldest Commuter swallowed that up, and after a time there was a row

of comfy old-fashioned chairs all around the edge of the dingy baggage-car, and an atmosphere of smoke and good stories that warmed the cockles of the baggageman's heart. You could have raised $100,000,000 for an enterprise from the crowd of men who rode regularly in that little car, but the baggageman neither knew nor cared about that. He simply knew that there was a good crowd of Commuters who rode with him daily.

After another little time the railroad took cognizance of that particular baggage-car. The general passenger agent, who was a fellow both wise and solemn, talked with the general manager, and one day that little club of Commuters had a surprise. Instead of their baggage-car, the down train hauled a bright new car all fitted with fancy things — curtains and carpets and big stuffed chairs, and the baggageman was rigged out in a fine new uniform as an attendant. The general passenger agent fondly imagined that he had made the one really happy stroke of his existence.

He had not. His was a colossal mistake. The "club" called for its baggage-car back again. Its members were men who were surfeited with mahoganies and impressive stuffed chairs and thick carpets. They demanded their old dingy car, with its four little windows, its rough board floor and the wooden armchairs. They got it back. The big, new, showy car was sent off upon another route; and the baggage-car — itself a club to which many a soul enviously craves for admission — makes its run six times a week on one of the fastest expresses on the line.

Groups of men have staterooms regularly reserved for them in the parlor cars of the finest suburban expresses, and there is never a word said of what goes on behind those closed doors. There come whispers of "antes" that are as high as a church steeple, but the railroad does not concern itself with the morals of its passengers to the point of breaking in upon closed doors. The porters may know, but the porters are traditionally wise and more than

traditionally close-mouthed. One big New York editor hired a stateroom for his daily ride in and out to his suburban home. His secretary and his stenographer are closeted in it with him, and on the 50-minute ride twice each day he dictates the daily editorial utterances that delight a great congregation of his readers.

Special trains for Commuters are no particular novelty. Almost every big system has some daily suburban trains that are on its working time-tables and not upon the schedules that are given out to the public. A group of aristocratic Commuters living north of Boston in the district around Manchester have their private special into the North Station every summer morning. It is an all-parlor-car train, the most luxurious suburban on the line, yet not one Commuter in a thousand knows a thing about it. A similar train arrives and departs daily at the South Station. Others are in service out of New York. You can buy both exclusiveness and elegance from the railroad.

The Commuter is not more concerned about that 5:37 than is the railroad. It makes train and Commuter both its concern, because that is the way it seeks to build up its profitable suburban traffic.

"We are getting more of the city out into the country each year," says a big suburban passenger agent; "and with the wide increase in the use of electricity as a motive power for the standard railroads this business is bound for increases that we can hardly foresee to-day. I think that I am quite safe in predicting that another decade will see the belt of from 30 to 50 miles outside of New York terminals as thickly settled as the belt from 10 to 30 miles is to-day settled. The railroaders have done their part by expensive increase in terminal and track facilities; they have helped the real-estate men in their broad advertising of the possibilities of suburban life: the harvest is all that now remains to be reaped."

CHAPTER XX

FREIGHT TRAFFIC

:OME FROM FREIGHT TRAFFIC GREATER THAN FROM PASSENGER — :OMPETITION IN FREIGHT RATES — AFTERWARDS A STANDARD RATE-:HEET — RATE-WARS VIRTUALLY ENDED BY THE INTERSTATE COMMERCE :OMMISSION CLASSIFICATION OF FREIGHT INTO GROUPS — DIFFERENTIAL FREIGHT RATES — DEMURRAGE FOR DELAY IN EMPTYING CARS — COAL TRAFFIC — MODERN METHODS OF HANDLING LARD AND OTHER FREIGHT.

[N England they speak of it as "goods" and regard it as almost a minor factor in the conduct of their rail-ays. In the United States it is freight-traffic, and is the hing from which the railroads derive by far the greater art of their revenues. In England it is represented by elicious little trails of "goods-wagons," four-wheelers of rom five to eight or nine or ten tons' capacity, the goods" often left exposed to the rigors of winter, save or possibly a tarpaulin covering; in the United States, ast-freights and slow-freights crowd upon one another's eels; the sixty-ton steel car has long since come into s own.

If you do not realize the importance of the freight traf-c, you should talk to those shrewd old souls in Wall treet who measure a carrier, not by its ticket sales, but by hat fascinating thing that they call "tonnage"; you hould go out upon the line and ask any operating man ow his territory is holding up in traffic. He will an-wer you in tons, in freight-cars moved within a single wenty-four hours. If you are still unconvinced, go to the assenger man you know best. He will tell you that while : is pleading vainly with the biggest boss of all for some w Limited, eight or ten passenger cars all told, some ouldering freight-hustler has been welcomed into the

inner sanctum and comes out with an O. K. for 800 or 1,000 box-cars or gondolas in his fist, a dozen new freight-pulling locomotives in addition, for good measure. There is your answer.

The passenger terminals may have all the magnificence in which we have seen them, but the freight terminals are the real core of a railroad's entrance into any town. For when you come to even the roughest figures, you find that in extreme cases — such as the New Haven's, where there is a congested territory, closely filled with thickly populated cities and towns — the passenger receipts will hardly do more than approach a balance with those from freight. In some cases the passenger earnings are hardly 25 per cent of the railroad's entire income; and cases like these are more common than the New Haven, holding New England as its own principality. Wonder not that Wall Street looks askance at any new line until it can prove itself able to develop "train-load"— freight traffic, measured in thousands of tons.

Your general freight agent, who is a sort of official cousin to the general passenger agent, is the man who studies tonnage. More likely in these days of the exaltation of titles, he is the freight traffic-manager, with a group of subordinates around him and a traffic-skirmishing corps out on his own road and the other connecting roads, who are making friends with shippers, just as the young travelling passenger agents round up the theatrical managers and the brethren from the lodges. The travelling freight agents hang around sidings and breathe affection for manufacturers and wholesalers; they welcome to their very arms the business traffic-managers, who are really glorified shipping clerks for great big concerns. And while they cultivate the road in detail, their big boss studies the territory in general. The trade papers and the market bulletins litter his desk; he can tell you strength or weakness in this thing or that — why cotton is off, and wheat rushing upwards. Moreover, the freight

raffic-manager, himself, is not above friendships. He will pack his own evening suit into a bag and go 500 miles willingly to give shippers his own private explanation of the national rate complication.

Did we say rate complication? That seems almost too simple a name for the subtle and intricate structure which tells us how much we must pay the railroad for the transportation of our goods. When we were visiting the passenger office, we saw something of the work of the rate-clerks there. We learned that, in fact, the railroad creates various classes of rates in the first place; local or round-trip tickets, at, say, three cents a mile for occasional travellers; mileage books for more constant travellers, which bring a wholesale rate of two cents a mile; a third and lowest rate of something less than a cent for that urbane soul, the Commuter. For excursions, where many, many persons were to be moved at one time, perhaps upon a single train, other very low passenger rates were created. We also saw how the railroad, trying to base its passenger charges on the number of miles covered, is compelled to make delicate adjustments on through charges between competitive points.

We speak of these things now, because in a way the passenger tariff resembles the freight, and yet compares with it as a child's primer with a Greek lexicon. In an earlier day the thing was very much worse. In fact, at the very beginning there was no real scientific way in which the railroad might regulate its charges, and on some of the very earliest of steel highways the rates were made just half what they had been on the toll-roads, and without regard to the cost of transportation. Thus the competitive feature had its way early in the formulation of a rate-sheet; and there is evidence to assert that in those early days when the railroad had an opportunity it made its tariff as high as it thought folk would stand without a riot, and thus the now historic phrase "what the traffic will bear" came into coinage. As a matter of fact, in

those days when scientific bookkeeping was unknown the railroad had no way of accurately knowing just how much it cost to operate, and how that cost should be fairly apportioned between the different classes of its traffic.

The thing went from bad to worse as the great land carriers developed. Each made its rate-sheet according to its own sweet will; it classified freight precisely as it pleased, and the man down in New Orleans sending goods to New Hampshire was puzzled as to the charges that would accrue upon his shipment when it finally reached the northeastern corner of the country. The competitive feature grew to be the strongest in the making of the rate-sheet, unless it was the subtle influence of the railroad's favored friends, an influence that showed its ugly head oftener in the practice of rebating than anywhere else. The fierce competition that ruled between the railroads in the seventies has never been approached at another time. Ruinous rate-war after rate-war followed upon each other's heels, and little roads kept dropping into bankruptcy, one after another. There was a time in 1877 when a man might ship a carload of live-stock free from Chicago to Pittsburgh, from Chicago away through to New York for five dollars; and there is hardly a more expensive commodity for the railroad to handle, than cattle. To appreciate what these wars meant to the carriers, bear in mind that the week after this particular one was settled it cost the old rate — $110 a car — to ship cattle from Chicago to New York.

Out of such guerilla warfare came the one possible thing — coöperation. The railroads were not then big enough to consolidate their properties, J. P. Morgan had not then developed his fine art of welding them together. So they did the next best thing and made secret contracts — pooling. That is, they established a standard rate-sheet in their mutual territories and bound themselves to abide by it for a certain length of time. They figured out their relative percentages of business at the beginning

"THE INSIDE OF ANY FREIGHT-HOUSE IS A BUSY PLACE"

T. JOHN'S PARK, THE GREAT FREIGHT-HOUSE OF THE NEW YORK CENTRAL RAILROAD IN DOWN-TOWN NEW YORK

THE GREAT ORE-DOCKS OF THE WEST SHORE RAILROAD AT BUFFALO

of any agreement, and took from the combined earnings of the pool, the same percentages of receipts. The bitter outcry that went up across the land against pooling still echoes. That practice with another now also prohibited — rebating — really gave birth to governmental regulation of railroads.

In 1887 the Interstate Commerce Commission was born, and ruinous rate-warring practically came to an end. The Commission required the railroads to file with it copies of all their rate-sheets, both freight and passenger, and ordered that in almost every case thirty days' notice should be given of any change in the tariff. This meant that the old practice of tearing a rate-sheet apart in a single night, so as to jab vitally into the heart of a competitor, was at an end. And a dignified rate-war, with the opponents giving thirty days' advance notice of their strategic intentions, is almost an impossibility.

Now come to the present. The freight-rate system of to-day is intricate, fearfully intricate, but it is a system. It begins by classifying all manner of freight into groups, for it must be apparent to any one that to the railroad the cost of handling different commodities must vary tremendously. Several factors make for such variation: the value of the shipment and the degree of risk for its safe transportation that the railroad must assume; its bulk, its weight, and the cost of handling at terminals, as well as the cost of any special equipment that may be necessary to carry it over the rails. No one would expect a railroad to haul a box-car filled with several hundred thousand dollars' worth of silk for the same price that it hauled the same car filled with coke. So the railroad has grouped its freight into six general classes — varying from the most difficult and expensive to handle down to the easiest and the cheapest; and the rates for these six different classes also run in a rough proportion.

Some 8,000 articles, ranging from arsenic to step-ladders and from Christmas trees to locomotives, are grouped

into these classes. Into them has gone about everything that the railroad will handle, save coal and a few other specialties which are rated as specific commodities and have special published rates. So a man shipping feather dusters from South Brooklyn to Ogdensburg, N. Y., would find that they came under Class 1, and that he would have to pay 44 cents a hundred pounds for the haul. If he was shipping steel beams between the same points he would find them under Class 4 and he would find the tariff at 23 cents a hundred. These six classes have been made standard throughout the country by all the railroads in coöperation. The roads north of the Ohio River and east of the Mississippi use the so-called Official Classification; south of the Ohio and still east of the Mississippi, the Southern Classification; while all those west of the Mississippi use the Western Classification. So the shipper is no longer in much doubt in these matters, particularly in view of the fact that the three classifications are very much the same in all save minor details.

So much for the classification at this moment. It is quite simple when you come to place it beside the tariff sheets themselves, the printed form of an intricate structure, so great as to be almost shadowy in its workings. You ask a freight traffic-manager about rates. He is a skilled man, a man skilled in the economics of common carriers, and he tries his best to explain simply to you the basing charges for the transportation of commodities.

"Our rates," he says, "are formed by many things. In a general way, by the competitive territory into which we go, and in specific cases by the volume of business that comes or goes from a single point. The direction of the movement, including whether cars must return empty or loaded, is another factor. Then, of course, there is the great factor to which both passenger and freight rates must comply — the necessity for the railroad earning more than it pays out. Acworth, the English economist, says that a railroad must pay for three things, the expense of

aintaining the organization, that of maintaining the lant, and that of doing the work. Our revenues, from ne source or another, must meet that triple expense."

Ask this big freight-man about charging "what the raffic will bear" and he looks grieved. He turns about harply and asks you:

"The earning-sheets of every railroad are public and hey will show you that they are but making expenses, in . few cases paying about half the dividends that a healthy ational bank or trust company or manufacturing enterrise might be expected to return to its investors. That nakes it look as if we had begun to get some sort of cientific adjustment between expense and revenue, does t not?"

You dodge the point. You have no desire to quarrel r to delve into high railroad finance, and so you say you imply want to know about rates.

"It 's a little simpler than Sanscrit," says the freightan. "We begin to figure on common or basing oints—"

You interrupt and inquire as to what a "common oint" really is. Then the traffic expert gets down to rimer talk and begins to explain the thing to your real unerstanding. It seems that some years ago, when the railoads first "pooled" they had to find an equitable method f making a rate-sheet. Everybody made suggestions, and Pennsylvania freight-clerk, named James McGraham, ade the right one. It was adopted and became the tandard of to-day — which goes to show that good can ometimes come out of iniquity.

In this arrangement, the rate for each of the six different lasses and all the special commodities, between New York nd Chicago was made 100 per cent. Other towns, both urther and less distant from New York than Chicago ere given proportionate percentages, St. Louis being fixed t 117, Pittsburg 60, Cleveland 71, Detroit 78, Indianolis 93, Peoria 110, and Grand Rapids at 100 — the

same as Chicago. At the eastern end of this particular bit of territory — the Official Classification — a reduction of two or three cents a hundred was made from the New York rates in favor of Baltimore and Philadelphia, a corresponding addition of two or three cents to meet the increased haul to Boston. No matter how you ship freight, these rates now hold standard, as long as the railroads remain faithful to their traffic associations. You may ship from Indianapolis to New York by way of Cleveland and Albany, by Marion and Salamanca, by Columbus and Pittsburgh, or by Cincinnati and Parkersburg, and although there is quite a wide variance in mileage between these routes, the rate is the same on all the different roads that go to form them.

This standard, simple as things go in freight-rates, was not adopted in a moment. Bitter contentions on the part of cities and of shippers had to be settled before it ruled. After it ruled, it was easy for each road to build its own tariff upon it. Together these form a vast structure, one that is constantly changing, as one road or another changes its tariff under the pressure of shippers or of civic bodies, or possibly a desire to establish more equitable schedules; and the work these changes make can be imagined when it is stated that a single one of them in the Official Classification territory causes more than eight thousand changes in the rate-sheets of the railroads.

The choosing of Chicago as the "one hundred per cent" city in the northeastern territory of the United States repeated the compliment to her prowess as a traffic city, that the great yards which hedge her in for miles have paid her for many years. She is one of the very greatest basing points, where multiple rates or percentages are built from the single. Most of the very important commercial cities share this distinction, which is further shared sometimes by comparatively unimportant points that happen to be the terminals of rather important railroads. Thus we find Cincinnati and Henderson, Louisville and Evansville,

St. Louis and Davenport, Chicago and Peoria, Omaha and Sioux City, Kansas City and Leavenworth, all possessing this railroad distinction.

So much for the standard rates. Just as certain railroad lines running from New York to Chicago are permitted to charge two dollars less for tickets than other "standard lines," because of slower running time, so does the same factor make a "differential" in freight rates. Big roads boast that they can haul the first-class freight — the "preference freights"— from one city to the other in sixty hours. Others take a longer time, and are permitted by their larger competitors to make their prices a shade lower because of slower running time in freight service. Such a "differential" is the Grand Trunk, handling New York-Chicago freight by a roundabout route, from New York by water to New London, Conn., and thence over the Central Vermont up into Canada and the Grand Trunk's main line. Obviously such a longer route adds to the running-time and would be at a keen disadvantage in securing travel, without a lower rate as bait for the shipper. We have used New York-Chicago differentials simply as illustrative cases. The differentials are apt to be found in any corner of the country where there are long hauls and a number of railroads fighting to secure them.

But the Grand Trunk as a factor in Chicago traffic to and from Boston brought one of the earliest and most interesting decisions from the Interstate Commerce Commission. St. Albans, Vt., complained to that board that its local freight rate by Boston & Maine and Central Vermont from Boston was higher than the through rate from Boston to Chicago. On the face of it, it seemed as if justice must have rested with St. Albans, but the railroad was able to prove its case and win a decision. It showed that it could not live on shipments between Boston and St. Albans and other local non-competitive points, or on the business interchanged between these

points. To earn its bread and butter it must fight for the rich Chicago traffic; and to be in a position to fight for that traffic, despite some disadvantage of location, it must make very low rates.

It proved that these low rates were possible for business that went through in solid trains, like Boston-Chicago traffic, and that each of these trains earned its proportion of the railroad's profit. For when you come to handle freight at St. Albans, more particularly the case in still smaller towns, you bring on a new traffic expense, and because of this expense we get what is known as "back haul."

On the "back haul" small towns suffer and must probably continue to suffer until a still more equitable system of railroad rates can be devised. Sometimes it may come about in such a case at the St. Albans one just cited; in other times because of water competition, as in the famous Spokane case, to which we shall again refer; and sometimes it is merely an arbitrary charge laid by the railroad. In such cases the railroad reasons that it would cost, in time and train delay ten dollars for every dollar's worth of freight switched off and delivered at certain small towns; and so it figures upon hauling to the nearest large division point with large yards, and sending it back from there on a way-train. When such a small town is nearer the division yard at the far end of the route the back haul charge develops, and the small town must grin and bear it. If the small towns and the small cities, with their vigorous organizations, begin to complain too bitterly of the present system, the traffic experts will turn to them and say:

"Devise a better system. Perhaps you would like the Australian system, where the charges diminish per mile, for each additional mile covered by a consignment?"

That may look good to the Secretary of the Chamber of Commerce, who has come down to headquarters with *wrath* in his eyes; it looks absolutely equitable to every

one; and he nods yes. The traffic-manager gleams with joy. His quarry has stepped into the trap. He turns upon him.

"Where would your dandy little town of 35,000 contented folks be under the Australian system?" he demands. "The Australian system would concentrate all business at water traffic points, along the seaboard and the great lakes and rivers; it would concentrate all manufacturing at the points from which comes the raw material. Where would the seven wholesalers of your town that we are all so proud of be located under the Australian plan? If the railroads were to adopt it, it would save millions of dollars in bookkeeping alone, but there would not be an interior distributing point in the entire country."

The Secretary of the C. of C. is flustered. He was a young newspaper reporter before he reached his present high estate. He flounders. The traffic man is a man of ready wit and even readier figures. Still the young Secretary feels that he must show a few grains of wisdom, and so he gently makes inquiry about the Spokane case.

That Spokane case, also a famous decision of the Interstate Commerce Commission, shows another factor in railroad rate-making, the serious influence of water competition. Indirectly it also includes the principle of the back haul. Spokane, which is much nearer Chicago than Seattle, was, like St. Albans, paying a higher rate for the "short haul" than Seattle was paying for a much longer haul. But Seattle is a prosperous port, and if the railroad did not make a very low rate to it, all the slow freight would go to it by water, where much lower transportation expense invariably makes much lower rates, and the railroad, to save its own skin, as it were, must make a low through rate there, charging a back haul or higher rate to Spokane from the large eastern points. If it charged Spokane a proportionate rate of the one to Seattle, which would then be lower, all the other inland towns would demand the same privilege, and the railroad

would then be hauling property at a loss — a business which can have but one inevitable result.

"You see how complicated it all is," the traffic manager tells the young Secretary, "and how we must use judgment all the while. We 've got to figure individual cost for certain distances and localities and directions of traffic, figure in the varying cost of handling different sorts of freight, and then put in a percentage of the general cost of the business, just as the restaurant-keeper makes each patron pay proportionately for the cost of bread and butter, heat, light, service and rent, no matter how large or how small his check may be on any one occasion.

"We must use judgment, and we must make rates to keep the goods moving all the while. Suppose that both nails and crowbars are made in Pittsburgh and only nails are made at Williamsport. Suppose then that the rate from Pittsburgh to New York for both crowbars and nails is fifty cents a hundred, but that the rate from Williamsport to New York was but 38 cents. What chance would the nail manufacturer in Pittsburgh have against his competitor in Williamsport, when both men are making annually nails in tens of thousands of tons? It is to help the Pittsburgh man that we make a special 38-cent rate on nails from his town to New York; and when we keep filing these commodity rates at Washington, your shippers ask why we can't have a standard rate-sheet, or the Australian system. The next time some one of them finds that he cannot sell plough shares in Texas because a man down in Fort Wayne has him beaten on standard rates, you watch him hurry here and ask for a special one.

"It is out of this clamor and contention of almost myriad interests, the ambitions of just such thriving little cities as your own, out of the skilled arguments of brainy men that the rate-sheet is born and kept living in a state of perpetual healthy change."

We are tired of rates and the factors that go to make them, and inquire what is the A, B, C of a freight transaction between the railroad and a shipper. The traffic-man makes it quite clear to us.

"When one of our agents receives a consignment of freight," he says, "he immediately issues a bill of lading to the shipper, or consignor, as a receipt and as a contract for the shipment. From his duplicate of this bill of lading he makes out a way-bill, or manifest, which will accompany the car until the freight reaches its destination. This way-bill describes the shipment and the car into which it has been loaded, specifies the shipping point and the destination, the consignor and the consignee, the rate and whether or not the charges have been paid in advance or are to be collected at destination. A copy of this way-bill is given to the freight-conductor, who gives the station agent a receipt for the consignment. At that place of destination a freight-bill, containing a description of the shipment similar to that of the way-bill, and showing in addition the total charge collected or to be paid, is rendered to the consignee, and his receipt is taken for the shipment when it is delivered."

"It seems quite simple," you breathe softly.

"It is not," is his reply, "for it has its complications. I 'll show you one of them."

We step through swinging doors of green baize and for a moment from a traffic into an operating department, but an operating department that for the telling in a work of this sort is best allied with the story of the freight traffic. The traffic-manager points to a man sitting at a square and littered desk, his thoughts with sturdy intent upon the mass of correspondence which he is quickly sifting.

"He is the best car-service man in the country," says our guide; and you recall when you were in the auditor's office, that an accounting was being kept between the lines for the use of one another's cars that went on through

runs off upon strange or "foreign" lines. The traffic-man continues: "Ours is not a big road, as some roads go. Yet we receiv about 40,000 cars a month and, of course, deliver something like the same number in the same thirty days. Yet there is not an hour of any day of the month that this man cannot tell where any one of these cars is, just how long it has been upon our tracks, just how much free time the consignee has for unloading it, or just how much he will have to pay the railroad for his delay in emptying it, so it can get back into service once again."

That waiting charge, the traffic-man explains, is known in the parlance of his business as "demurrage"; and it is another keen example of the constant use to which a railroad puts its equipment, of the tremendous economy that is beginning to be practised in the modern science of railroading. You are introduced to the car-service man, bend low over his desk as he explains a bit of his work to you. Here, for example, is a car filled with automobiles bound from Detroit to a dealer in Worcester, Mass. This car, in a train of some 60 others, leaves Detroit east-bound over the Michigan Central Railroad. At Buffalo it is switched to the tracks of the New York Central & Hudson River Railroad. On the evening of the second day it arrives at Rensselaer, across the Hudson River from Albany, and is given over to the Boston & Albany Railroad. To make a concrete instance, let us see how the B. & A. handles the thing through its car-service department.

That department swings into quick action automatically, as soon as the car strikes B. & A. rails at Rensselaer. The freight agent there makes a note of the car and its contents from the way-bill which accompanies it; makes special note, perhaps, of the fact that it is a car designed particularly for the transportation of automobiles. Now let us presume that this big box-car is owned by the Michigan Central. The Boston & Albany will pay that

owner railroad 35 cents a day rental —"*per diem*," in the phraseology of the railroads — for the time it is upon B. & A. rails. There are at that very time perhaps hundreds of B. & A. cars on the Michigan Central, and at the end of 30 days these accounts and many, many others are sent to the auditor's department, where they are balanced between the roads with the general freight and passenger accounts.

This movement of freight cars makes a valuable barometer of the general condition of business. The daily papers have a custom of making national compilations of car-service reports part of their most interesting market news. In dull seasons the cars come home from long service on other roads. But in very busy seasons all roads have little compunction about borrowing "foreign" cars for use in their local service. With shippers begging cars from every quarter and threatening all manner of dire things, 35 cents daily is a small rental to pay for the use of a roomy car. Besides, the other fellows are all doing the same thing, and no one road can hope to get all its cars back even with the use of a vigilant corps of young men who search "foreign" yards. But in the dull seasons they come trundling home, like lost cattle finding the big barn once again. In the business depression of 1907, a Western car-service man received cars that had been absent from the home road for seven years.

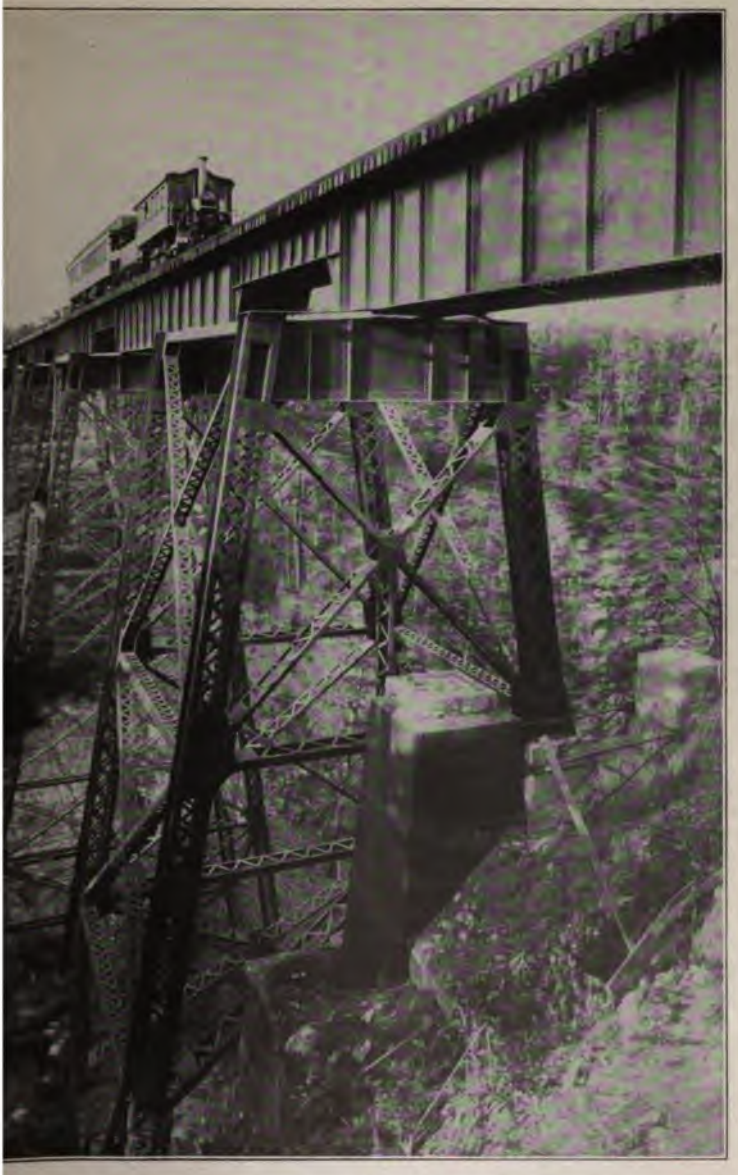
We turn from the car-service men back into a department that is strictly traffic. Coal service is one of the principal sources of income for this particular railroad. It stretches some of its branches into bituminous fields, and others through the anthracite fields that Nature, in some freakish mood, implanted in just a few counties of Northeastern Pennsylvania. That entire country is comparable to a cut of beef, the coal veins resembling streaks of fat that run hither and thither. As in beef, the lean predominates. The fat streaks are the valuable coal veins, the lean the earth, slate and rock in which the coal

was planted during some great convulsion of Nature in the process of the creation of the world. How it got into this particular spot science cannot tell. What it is, further than the fact that it is mostly carbon, science only guesses. It guesses that it was originally bituminous coal and that by some process of intense squeezing in an upheaval of Nature, the oil and tar and gas of the bituminous coal was squeezed out and the much more valuable anthracite deposits created.

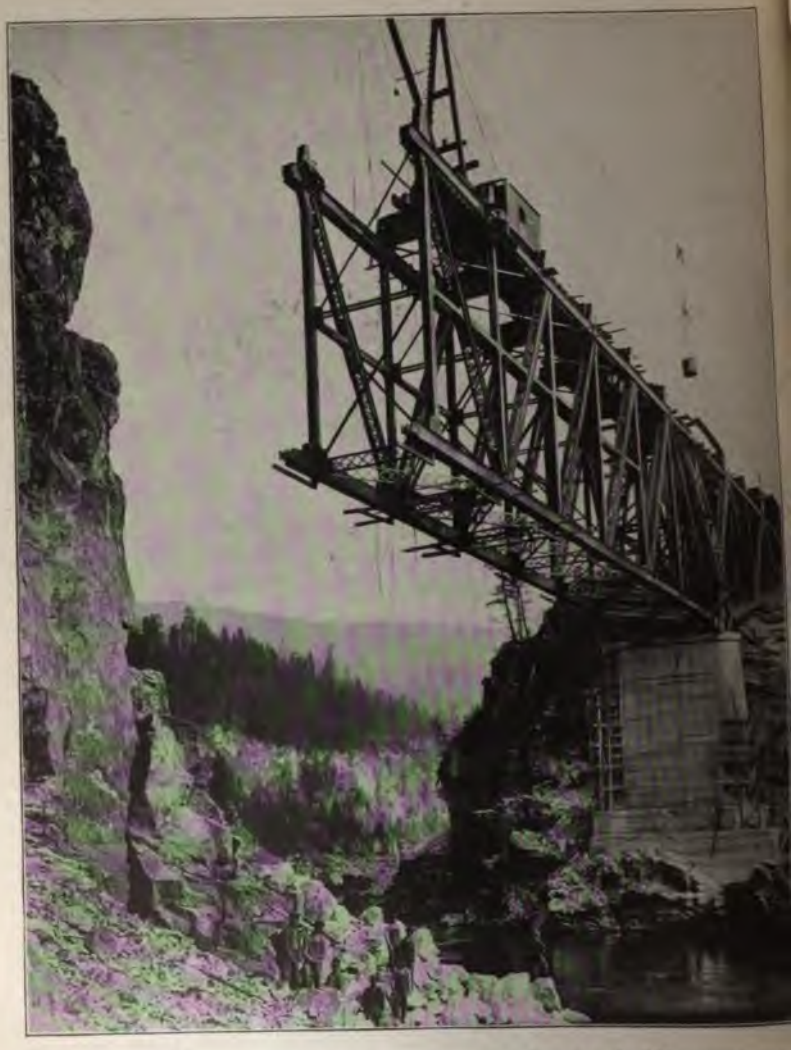
Mining consists in getting the streaks of fat anthracite out of the bulk of lean earth and rock. The veins run well down into the mountains, and, as do the little streaks of fat, lose themselves in the rock, or lean, to continue the simile. Some of the veins are but a few feet in thickness, while some run to as high as twenty and thirty feet, and, as a rule, the farther down into the earth they go the better the coal; and the farther down you go the more difficult and expensive is the mining.

Now, here is a traffic that demands and receives special attention. In other days the mining of anthracite coal was, itself, merely a department of operating for the half-dozen systems that stretched their rails into that valuable Pennsylvania corner. That work has now been removed into the control of separate mining companies; but the handling of coal is a great function of not only these roads, but of the systems that reach their tendrils into the valuable bituminous fields here and there about the country.

To fill the coal-bins of New York City alone, requires some 10,500,000 tons of anthracite yearly. Now you cease to wonder why this road has a coal traffic expert, a man of surpassingly good salary. He keeps keen oversight over the operating department in its handling of this giant traffic, sees to it that the trains come over the mountains and into the great terminals at Jersey City in good order, and that the railroad's marine department is ready with tugs and scows and lighters to handle the prod-



THE GREAT BRIDGE OF THE NEW YORK CENTRAL AT WATKINS GLEN



BUILDING THE WONDERFUL BRIDGE OF THE IDAHO & WASHINGTON NORTHERN OVER THE PEND OREILLE RIVER, WASHINGTON

it comes in, in thousands of tons every twenty-
ours. This would all be quite simple if the trains
e boats were always running on schedule. But the
ected constantly comes to pass in railroading, and so
ilroads provide against emergencies by establishing
coal storage plants outside of New York and other
cities — communities that would be in dire distress
ir coal supply were cut short even for twenty-four
. Sometimes about 500,000 tons will be kept in a
one of these storage piles — a black mountain run-
lengthwise between sidings and served with giant
.

are back in the traffic-manager's comfortable office
final word with him. He is fumbling with his own
pondence. It seems that a lawyer down in Wash-
has been saying that he could save the railroads
land a million dollars a day in the economical oper-
of their property, and the railroader is exceedingly
at that assertion.

He speaks of pig iron, and says that we should teach
borers the minimum movements necessary to put a
pig in a car — just as masons have been taught to
brick with minimum effort and a maximum econ-
n work accomplished has been effected." The traf-
n laughs, rather harshly. "The lawyer is all right,
for two things; and his anecdote about the brick
ainly well told. Only it just happens that the rail-
does not load or unload freight by the carload —
s the duty of the consignor and the consignee —
t also happens that pig iron rarely is handled
.L." In carload lots it is not loaded or unloaded
nd, but by big magnets on a crane which picks up
of the bars at a time and thinks nothing of it."

freight traffic-manager has made his point once
and he is satisfied. He tells a little of the modern
ds in freight handling, one of them how an in-
s packing-house expert in Chicago saved thousands

of dollars annually in the handling of lard. In other days lard was rolled aboard box-cars, a barrel to a hand-truck, a rather slow and a rather costly process. The Chicago man devised a method of melting lard and, while it was fluid, pouring it, like petroleum, into a tank-car. When it reached its destination at some big terminal, the lard was again melted to fluid and poured out from the tank. That is the science of big freight handling to-day. Not alone do cranes, with magnet-bars handle pig-iron and castings by the ton, but great hoists at Cleveland and Conneaut and the other big lake towns close to the Pittsburgh district reach deep into the hearts of giant ships, bring from them the ore of Lake Superior's shores, and fill the whole waiting trains within fifteen or twenty minutes. Into the empty holds of the ships they pour bituminous coal from Western Pennsylvania and West Virginia, a carload at a time. The hoist-crane reaches down to the dock siding for a gondola, snaps the car-body off from the trucks, lifts it aloft over the open hatch of the waiting vessel, and turns it upside down. In less time than it takes to tell it, the coal is in the ship, and the car-body is being slipped back again upon its trucks.

CHAPTER XXI

THE DRAMA OF THE FREIGHT

FAST TRAINS FOR PRECIOUS AND PERISHABLE GOODS — CARS INVENTED FOR FRUITS AND FOR FISH — MILK TRAINS — SYSTEMATIC HANDLING OF THE CANS — AUCTIONING GARDEN-TRUCK AT MIDNIGHT — A HISTORIC CITY FREIGHT-HOUSE.

PERHAPS you have seen a gay Limited in green and gold start forth with much ado from some big city station, and have concluded that the romance of the railroad rests with it; that the long lines of murky-red freight cars have little of the dramatic about them. If you have thought that, you have thought wrong.

Romance and drama reach high climax sometimes in the transportation of commodities. Fast trains, running upon the express schedules of the finest Limiteds, sometimes bring silk, $2,000,000 or $3,000,000 worth to the train, across the continent. A special may be hired by some impatient manufacturer to send a shipment through half a dozen States. There are notable speed records in the handling of fast freight, records of notable trains that are as well known among the traffic specialists as the Limiteds are known to the outside world.

There is drama, too, when the railroad brings the food up to the city, for it counts as one of its greatest functions this filling of the city's larder. It sets aside certain high officers in its traffic department for the handling of market produce; it provides special facilities for gathering it, special facilities for moving it, special terminal facilities for delivering it in the hearts of the great cities. Sometimes it even goes further and provides and organizes great wholesale markets, building up its traffic by

going as far as possible in facilitating the constant replenishing of the city's larder.

That is why these long dark caravans, the fast preference freights that are the pride of the railroad's traffic head, go so quickly over the rails to town. One of them halts in block for an instant to let a brightly lighted passenger train go in ahead of it. While it is halted we climb aboard and engage its conductor in conversation. He is a clever fellow, of the type of the coming railroader. Only last summer, we found a freight conductor thumbing his "Sartor Resartus," and discussing Carlyle as a stylist.

"Yes, we do bring some food up to town," he admits. "I 've got enough grub aboard these eighty cars to feed several regiments. We 've two refrigerators of meat from Omaha, two from Kansas City, one from Chicago. The Chicago car has been iced twice — at Elkhart and at Altoona. The other cars had to have an extra filling at Hammond, on the outskirts of Chicago. Soon we 'll have crisp cold weather and we can cut out the icing.

"The boss? The boss will be worrying still. Just as soon as he can cut down his refrigerating stations at the division yards, he 'll be fretting about getting those big ice-houses filled for next summer. He 's got a lake tucked up in the mountain divisions somewhere, and we 've got a branch running in a couple of miles there, and we just pull out the ice during the winter months. You take any of these trunk-lines and it has to have a lake for its refrigerating stations. It 's just one of the many little kinks in running a road."

We express a desire to see the big preference train, and — the block being still set against her — we go forward in the black shadows of the cars, the train boss's arm-set lantern showing our way to us. He stops beside a string of white and yellow box-cars.

"California fruit," he says; "they don't think anything of sending it all the way across the continent. You

might have thought those ranchers over there on the Pacific coast would have been discouraged when they were told that there were a dozen icing stations between the two oceans, and that the icing cost was prohibitive. They were n't a bit. They just sat down and did some tall thinking, and after a while they developed this type of car. We call it pre-cooled. The car is cleaned and brought to a chill before loading. After that the temperature is not allowed to rise while the fruit is being piled away inside. It is closed and sealed, while still ice-cold, and icy-cold she comes bumping her way east over three or four thousand miles of track. It may be scorching down there along the S. P.; they may be just gasping for air in the Missouri bottoms; but that pre-cooled car comes right along, keeping its cargo fresh and cool and pure. We can deliver her anywhere here on the Atlantic seaboard, and no risk of spoiling the stuff."

We slip along another half-dozen cars. The conductor halts again and fumbles with his way-bills.

"There 's the boy," he laughs. "He 's halibut. There 's half a dozen halibuts along here in a string."

We do not like to show an utter ignorance of the food question and we venture an assertion.

"Halibut comes from Newfoundland?" we ask. "How do you get it around here?"

The freighter grins sympathetically at our lack of knowledge.

"Bless you," he says. "That little fishing pond up there on the Banks is n't big enough for a land which has 27,000,000 folks gathered in its cities. These cars have come in from big Yem Hill's road — all the way from Tacoma up on Puget Sound — State of Washington. Some of those people who live in Boston might have a fit if they knew that their beloved halibut was born and raised in the Pacific Ocean; but that 's the truth of the matter.

"This fish (and some of it 's going straight to Boston

to be sold in the very shade of Faneuil Hall), has come 7,000 miles to be eaten on the very shores of the Atlantic. When the fishing ship that caught this cargo was fifty miles off the docks, she began calling Tacoma with her wireless. The yardmaster of the Northern Pacific was ready there for the news from that rat-a-tap. He had a string of refrigerator cars ready; they were ready and set out along the wharf by the time the ship was made fast.

"Five minutes later the fish were being loaded into the cars. They had a gang of stevedores working there clock-like, as those fellows work around the big tents of a three-ring circus. First there went in a layer of ice, then a layer of fish, then another of ice. In thirty minutes the job was done. In forty-five minutes that string of fish-cars was coming east on an express-train schedule. It was knocked apart at St. Paul and again at Chicago. Here's our share of the spoils, and we're not loafing here on the old main line.

"We're preference freight, if you please, and no old bumpety-bump with coal and ore taking the low-grade tracks. They sandwich us in among the all-Pullmans, even when we're on the four-track divisions, for food is quick; food won't keep forever; and those folks down in the city are getting hungry."

He starts to say more, but the engine call halts him. The block is clear once again. The conductor catches a car step, the "preference" starts forward with all the rattling shakes and bumps peculiar to a long freight train. In a minute or two the red tail-lights are grinning at us from half a mile down the track. Another big freight goes scurrying by us — more market stuff, more meat, more fish for the hungry town, a town which houses 4,000 folk within a single congested tenement square. A third train follows; all refrigerator cars it is too. They come in quick succession, these market trains, to the metropolis. The railroad is doing its part. To-night again, the food *is* going up to the city.

The scene changes. Now we are off in the rolling country of up-State — dairy country, if you please. The railroad that stretches its thick black trail the length of the valley is no four-track line, with heavy trains coursing over it every three or four or five or ten minutes. This is but a single-track branch; in the parlance of the railroaders it is a "jerkwater"; and the coming of its two passenger trains and that of the way-freight each day are events in the little towns that line it. Still, even this little branch is doing its part in the filling of the city's larder. This branch has the filling of the city babies' milk bottles as its own particular problem.

At early dawn, the muddy brown roads that lead to the little depot there at the flour mills are alive. The farmer boys are bringing the milk to the railroad. Down the track a few hundred yards beyond the depot is the slick, clean, new milk-station. Over across the brook is the cheese-factory, deserted and given over to the gentle fingers of decay. Those two buildings tell the story of changing times; in their mute way they tell the growth of the American city.

In other days this township made cheese. To-day they drive the milk to the depot. Each morning finds a big refrigerator car, built in the fashion of passenger equipment, so that it may be handled on passenger trains, at the milk station. The farmer boys are prompt with their milk, it is checked and weighed and placed in the car, in cans and in bottles. Hardly has the last big ten-gallon can gone clattering into the car before the whistle of the warning local is heard up the line, just beyond the curve at the water-tank. While the train is at the depot, in all the bustle of the comings and goings at a country station, the engine makes quick drill movement and picks up the milk-car.

Farther down the line that same train picks up more milk-cars. By the time it reaches the junction where it intersects the main line it is a considerable train for a

branch line. Indeed at the junction there are more milk-cars, from other branches that ramble off into the real back-country. There are enough of them now to make a train through to the city. The trainmaster has a good engine ready for every afternoon, and the milk express goes scurrying into town with passenger rights and on passenger schedules. You cannot hurry the babies' milk through to town any too quickly.

This is all first-day milk. You can take a compass, place the pin-leg squarely in the heart of the busy town — a place of brick and asphalt, of steel and concrete, without ever a hint of growing things — and with the pencil-leg trace a segment of a circle — the outer line some 200 miles distant from the centre. Afterwards you can draw a second circle segment, its outer line some 350 miles from the same town centre. From within the inner circle comes the first-day milk, delivered to the railroad during the early part of a day and on the householder's table in the big city the next morning. From without this inner circle and within the outer, comes the second-day milk which has another twenty-four hours in its transit to town. The whole thing, once rather badly handled by itinerant single dealers, has been reduced to scientific business by skilful coöperation between the big milk-dealers of the present day and the railroads.

It is night.

The last of the office lights in the towering buildings has been snuffed out. Downtown is quiet — quiet for a little time, for soon after sun-up it will be a vortex once again; these narrow, deep-canyoned streets will be astir and human-filled once again. But at nine o'clock in the evening the policeman's footfall on the pavement echoes in lonely streets. A tired bookkeeper scurrying home after a vexatious hunt for his balances gets sharp scrutiny from the policeman. Downtown is asleep.

Then, from around the turn of a sharp corner comes a

night train of wagons, drawn by a small brigade of horses. These are not filled with market-truck; market-truck will not reach the town till midnight at the earliest. These are great high-boxed vans, painted white, a bit gaudy in lettering. They make you think of those long-ago days when you used to go down to the depot to see the circus come in, for the big wagons are precisely like those that used to shroud mystery as they rolled from the trains down to the show-lot. We follow this procession of half a dozen great vans, follow it through the twisting, narrow streets of downtown, across a famous old ferry, straight up to the long sheds of a railroad terminal.

On the one side of the terminal, the passenger trains are coming and going at all hours. By day this shed at which the big vans back, each into its own carefully marked place, is a general freight-house; by night it is given over to the stocking of the city babies' milk bottles. The ferried vans are hardly emptied of their empty cans and cases before the first of the milk trains comes backing in at the other side of the long covered platform. Hissing arcs up under that slimsy roof throw high lights and deep shadows here and there and everywhere. They show the platform-men tugging at the car fastenings before the brakes are fairly released. In another minute, the big side-doors are thrown open, almost simultaneously, in still another, the place is alive with the rattle of trucks. The milk — tons upon tons of it — in ten-gallon cans and in cases of individual bottles, is being loaded within those circus-like cans. A second milk-train comes bumping in at a far platform. There is another brigade of vans waiting for it there. A third train is due to arrive in another half-hour. The vans that it will fill are already beginning to back into place and unload their cans and cases upon the platforms.

Here are almost 200 great four-horse trucks being filled simultaneously, and all working with the almost rhythmic harmony of organization. You want to know how they

do it? Ask that man over there, he in a short rough coat, who carries a lantern on his arm and with it peers interestedly into every one of the cars. That man's word is law on this platform, for he is its boss. He has been filling the babies' milk bottles from this particular terminal for almost a quarter of a century now. His railroad was the first to bring milk into a large city.

"We get it over," he will tell you, "by the experience of some little time, and by planning. You saw the numbers on the team side of this milk platform. That 's only half the problem. There are a dozen different milk-handling concerns doing business at this shed, and their stuff comes together on this one train. Yet we get the thing out by having each concern — each truck — come up to its own position at the team side. The other half of the problem we solve by having a certain position for each milk-car.

"Here is the Hygienic Milk Company up on the Heights. You have seen their fancy dairies all over town. Well, the Hygienic has a station up at Bottger's, on our Lancaster & Essex division, that fills two cars at that station every blessed day. Their two cars stand in beyond this No. 14 pillar every night; so we know just were to direct their trucks. That 's business — just system. We spot the cars every night."

"Spot the cars?" you interrupt. He smiles a bit at your ignorance.

"This train is made up in just the same fashion every night," he explains. "These two Hygienic cars are always the fifth and sixth. If they were the eighth and ninth some nifty evening — if some smart Aleck of a yardmaster up the line would take to shuffling up these cars as you shuffle a deck of cards — we would have a near riot here, and I could n't get these platforms cleared of the milkmen for that market-truck train that backs in here from the south every night at 11:55.

"So they keep closely to the formation of our trains,

INSIDE THE WEST ALBANY SHOPS OF THE NEW YORK CENTRAL: PICKING UP A LOCOMOTIVE WITH THE TRAVELLING CRANE

A LOCOMOTIVE UPON THE TESTING-TABLE AT THE ALTOONA SHOPS OF THE PENNSYLVANIA

"THE ROUNDHOUSE IS A SPRAWLING THING"

DENIZENS OF THE ROUNDHOUSE

and that of itself is no terminal problem. Away up the line 90 miles — 150,— 250,— everywhere that we have a big junction yard, the yard boss has his positive instructions about these milk trains. By the time this fellow has cleared out of P—— J——, 90 miles up the road and our nearest road yard outside of the metropolitan district, it 's always in just the shape you see it to-night. After that there 's nothing to be done here except cut off the road engine at our terminal yard and pick out a switcher to back her into position at this shed. It 's nice work, and night after night that engineer of the switcher does not vary four inches in the locations of these car-doors."

He lifts his lantern, and we peek into the interior of one of these cool milk-cars. This has the bottled milk in cases. The cases are packed four tiers high — never higher — and your guide explains to you that four cases is the limit of a hand-truck. All these things make for simplicity in handling. You peer into another car. The ten-gallon cans are in long diagonal rows, covering the entire floor of the car. They form a regular tessellated pattern, like the marble tiling of old-fashioned hotels and banks.

"Those little farmer boys," says the platform boss, "sure do that trick well. That speaks pretty neat for Sullivanville. They all used to put the cans in straight rows, running lengthwise of the car. One day one of the smartest of those Sullivanville boys discovered that by putting the cans in diagonal rows, this-wise, he would gain a hundred cans in the loading. That added a thousand gallons to the capacity of the car. The Super gave him a good job, and some day you 'll see he 'll be running a railroad of his own."

Midnight.

Downtown is still more deserted, if that is possible, than when we first saw it three hours ago. The stillness of the deep night is hard upon the city; yet here on this

broad quay street which runs its stone-paved length up and down past the wharves of the harbor-front, all is alive.

This is the midnight market. Under the very noses of the steamships that have brought this garden-truck up from the south, it is being auctioned off to a hundred or so keen-nosed, keener-witted wholesalers. They wander about under long awning roofs erected in the centre of the street, through the gaunt open shadowy spaces of the piers, poking into the tops of barrels, pinching, tasting, critically examining all the while that they are dickering in prices. When the day is fully born and downtown alive once again, there will be other wholesale markets, more sedate-looking affairs in rooms that have been built for the purpose by the traffic departments of the railroads. In these rooms, with the seats arranged in tiers and each seat having a broad writing arm like a college classroom, fruit and vegetables will be sold in carload lots. There will be records of prices — quotations. The thing will approach the dignity of those bourses where cotton and coffee and metals and securities are sold.

But the midnight market scorns such formalities, such dignities. It clings to its own hubbub — its own unsystematic way of accomplishing a great business. It prefers to sell as the stuff is unloaded; that has been its method for three-quarters of a century and any method that has stood 75 years is at least entitled to a measure of consideration. But not all its offerings have come by these big coasting steamships, whose outlines show vague at their piers in the darkness of the night. For, grinding against the piles of these same wharves, as the unseen tide changes, are groups of car-floats that have been ferried from the great railroad terminals across the river. Each car-float has two trackfuls of refrigerator cars — 12 or 14 or 16 in all — lined against a long roofed platform running just above keel. When the pert and busy little tugs have pushed and pulled and bunted the floats all

into position, the platforms are quickly connected by gangways, canvas-covered against the stress of hard weather. A great freight-house, almost Venetian in type, floats upon the surface of the silent river and becomes part and parcel of the pier itself. After that it is quick work to open each of the cars — to wheel out sample barrels of potatoes, of cabbage, of celery, of lettuce, of cauliflower — all the growing things of country farms that go to feed the hungry city.

The trading here is over in an hour, or two hours at the longest when the shipments are heavy; and then the wholesalers are wheeling their wagons into place to cart away their purchases to their own stores and warehouses. From these the retailers — the men who carry on their businesses in stalls in the public market-houses and those that have their own little shops on the street corners — make their selections. If you are a city man, you may now know that your grocer at the corner is up betimes, when the sun is just showing himself on lazy September mornings. He has been poking his way with his own horse and wagon down to the wholesalers, buying his day's stock and getting it placed just before the earliest of the housewives begins her marketing.

You demand a concrete example of a city freight-house; and here it is — the historic St. John's Park of the New York Central & Hudson River Railroad in New York. Up over the lines of the Central, back for hundreds of weary miles, you may hear the railroaders speak of "the Park," you may see long strings of cars, bearing merchandise tagged through to it. At Sixtieth Street, where the big freights of the New York Central come to a final halt, you see the cars sent south in long strings, each hauled by a red dummy locomotive and preceded by a boy astride a horse and holding a red flag, a familiar sight to all New Yorkers who reside upon the far west side of the town.

St. John's Park handles a very large percentage of all

the perishable food that comes into New York each day. It is the dingy freight-house that fills the double block between Hudson and Varick and Beach and Laight Streets; and when you ask, "Where is the park?" they will tell you that there was a day when the entire site of this freight-house — possibly the most congested in the world — was a gentle tree-filled square that faced old St. John's Church. There is never a trace of the park nowadays. The old church now faces a narrow street wherein truckmen shove and elbow and disappear in the gates of the freight station.

On the Hudson Street side of the structure six pairs of railroad tracks curve into it; and far above on the cornice of the structure one can see the benign figure of the old Commodore — a heroic bronze surrounded by replicas of the trains and the steamships that he loved so well. The building of the large freight station on the site of St. John's Park away back in 1868 was a real accomplishment to the first of the house of Vanderbilt. Think of it: that freight-house could hold 100 cars. There was nothing else in all the broad land quite like that!

Into St. John's Park at dawn come trainloads of produce. Even before the doors of the freight-house have opened, at six, a string of "coolers" has stopped in Hudson Street and the commission men are carting out the poultry. As soon as the station gets down to real business, butter and eggs and cheese pour in through it in carload lots.

"It does n't bother us much," the foreman tells you. "Still, on the Monday before Christmas we had a fairly brisk day. We had 155 cars of turkeys alone that morning."

CHAPTER XXII

MAKING TRAFFIC

ENTICING SETTLERS TO THE VIRGIN LANDS OF THE WEST — EMIGRATION BUREAUS — RAILWAYS EXTENDED FOR THE BENEFIT OF EMIGRANTS — THE FIRST CONTINUOUS RAILROAD ACROSS THE AMERICAN CONTINENT — CAMPAIGNS FOR DEVELOPING SPARSELY SETTLED PLACES IN THE WEST — UNPROFITABLE BRANCH RAILROADS IN THE EAST — DEVELOPMENT OF SCIENTIFIC FARMING — IMPROVED FARMS ARE TRAFFIC-MAKERS — NEW FACTORIES BEING OPENED — HOW RAILROAD MANAGERS HAVE DEVELOPED ATLANTIC CITY.

YOUR railroad manager of other days was content with the traffic that was offered him — if indeed he deigned to accept it all. For those were the business methods that obtained everywhere in the other days. When competition became the moving force in modern business, the railroad felt it. The land had become gridironed with tracks; business did not offer itself so freely as it had at the outset. When there came a division between routes of a traffic that had formerly belonged to a single route, earnings fell away and stockholders began to ask uncomfortable questions of the men who operated their railroad properties. Then the fight for business began — at first, as we have already seen, by a lively rivalry which showed itself in a merciless slashing of rates. Such fighting methods reacted on the railroads, and their rate-sheets became code and law, only a little less holy than the Federal Constitution, long before the Interstate Commerce Commission exerted its beneficent paternalism over the railroads of the land. But with the rates equalized between the railroads, the competition remained. The one obvious solution of the situation which was left was put into effect. The railroads began to make traffic.

The making of traffic is the most recent and the most highly developed branch of the science of railroading. The first of this specialized business-getting began just before the Civil War. Some of the railroads had put their lines back a little way from the western portion of the Great Lakes along in the late fifties, and they needed folks to live along those lines. It goes without saying that a railroad going into an unpopulated country would never be any great "shakes" of a railroad until people came to dwell along its lines. So the railroad from Galena to Chicago — afterwards the foundation stone for the mighty Northwestern — the Chicago, Milwaukee & St. Paul, and one or two others started emigration bureaus. Then men who owned those early railroads knew the possibilities of the virgin lands into which they stretched their rails. The proposition that confronted them was to let the folk who lived in the East and even those who were herded in the crowded lands across the Atlantic, know these same possibilities. By means of their first emigration bureaus they accomplished their proposition. Advertising was a crude science in those days, but advertising helped. Throughout the troublous years of the war the men from the East who had read of the glories of the Middle West, who had listened to the tales of the agents of the railroad and coupled them with those of returning travellers, began pouring over the new and struggling railroads. They carried their goods and chattels with them; and so the railroad men knew that they were not going back to the old homes again.

At the close of the war these tides rose to flood. The railroads no longer struggled. There was a steady flow of traffic over their rails, and they were able because of it to engage capital to stretch their rails a little farther west. After they had moved another stretch, the tides of emigration still flowed. That process might have

gone ahead in orderly fashion until the Pacific had been reached, if the scheme had not been upset.

They built too many railroads, they overworked their idea. In the broad reaches of the Middle West, lines of steel crumbled into rust, and cross-roads dreamed vainly that they would become villages. Many a struggling village failed to become the city that her enthusiastic residents had fancied. They had the big boom in Kansas, and the bigger collapse that followed. After that, folk stayed East for a while, and the business of making traffic in that territory became an advanced science.

There was another factor in the situation. You will remember that the Summer of '69 saw the first continuous railroad across the American continent — the combination of Central Pacific and Union Pacific. The huge success of that railroad was inspiration for others. In the generation of men that followed the rails that reached from Atlantic to Pacific were multiplied. After that there was a new problem for the owners of the transcontinental railroads. Their statistical charts of originating traffic showed great black masses at either end of the line — where connections were made with the great traffic-bringers from the East, and where the rails ran upon the docks of the Pacific shore. Between those two points was a thin black line, like spider-thread. To make that line black and firm at all points, to bring masses of new traffic at intermediate points, was the demand that the railroad-owner made of his traffic-manager.

It is being done to-day. It has taken time, money and almost incredible patience; but it is being done. This is a broad land, and there is still much to be done. In Montana, there is a single county with an area exceeding that of Maryland and a population less than that of the smallest ward of Baltimore; and near-by there is another county, as large as Delaware and Connecticut combined, with mere handful of residents. These are typical.

There are great open stretches to the southwest; and the Santa Fe, working hand in hand with the Harriman lines, is busy populating and developing these. In the North Country, James J. Hill's railroads and the new outstretched arm of the Chicago, Milwaukee & St. Paul are doing much to exploit the unfarmed lands of Montana, and the intensive possibilities of Washington for fruit-raising, market-gardening and the like. Up and down the Pacific coast, the railroads are uniting in similar campaigns of development.

Hill began the campaign in Montana. He is a dreamer and a far-seer. When he began making presents of blooded bulls to the farmers out along the Great Northern, folk laughed at him, some of his directors thought that he had gone crazy. They thought differently when they knew the results, when they got the traffic reports of the cattle business that was growing along the line.

That thing was typical. The railroad — Hill's railroad and all the other big transcontinentals — lent itself to the fine development of all the traffic that might possibly be obtained within its territory. Heretofore it had roughly combed traffic possibilities, now it began to screen them with a fine mesh screen. The emigrant bureau did its part of the work; the railroad went further and set itself to develop every inch of available land along its lines. Attractive excursions brought settlers to the new country, the railroad was of practical assistance in finding locations for them. Everything is being brought toward the development of those great new States of the West: cross-roads are beginning to become villages; villages, cities. A little time before his death, Mr. Harriman announced that there would be four great cities spread across the American continent — New York, Chicago, Salt Lake, and San Francisco. He then took it upon his own rather roomy shoulders to make Salt Lake City worthy of a place in the file.

From this activity in the West, the Eastern railroads have stolen a lesson. Originally built in many cases to serve the needs of the farmers of some particular locality, they have become merged and welded in a way that has caused them to serve the industrial interests of the country more particularly than the agricultural. One of the valuable old properties of the Pennsylvania Railroad in New Jersey rejoices in the name of Freehold and Jamesburg Agricultural Railroad.

When, after the serious slump in traffic that followed the panic in 1907, the railroads of the East found themselves, for the first time in a decade, with more facilities than freight, they began to cultivate more carefully the traffic branch of transportation science. They took quite readily to the lesson that the transcontinentals gave them. Then they proceeded to put it into effect in practical fashion.

For some years past the problem of the unimportant branches has been a serious one with the big Eastern systems. These branches, many of them once profitable feeders, have been allowed to deteriorate and retrograde, while main-line traffic developed and increased under active conditions of competition. The little towns along the branches seemed to retrograde too; while the busy cities of the country, strung along the main lines of the railroad, absorbed new growth and new energy. Sometimes the branch lines were paralleled by interurban electric railroads, which were able to operate at far less cost than steam railroads, and consequently to charge lower rates of fare; and their slight passenger traffic continued to grow lighter. The freight traffic had long since dwindled to slim proportions; the branch lines were almost entirely agricultural railroads; and the farmers of the East were discouraged and disheartened.

The new movement began in Western New York, which is fairly gridironed with a network of these unprofitable branch railroads. It was started even before

the panic of 1907. New York State, with its great resources and its fat treasury, has long been engaged in the development of scientific farming — which means farming for the largest profit that can be brought from the soil. It has a great agricultural school as a part of Cornell University, and an interesting experimental school along similar lines at Geneva. These schools have done a great work. They have educated young men to be modern farmers, in every sense of that phrase; and they have sent leaflets to every corner of the Empire State. But even these methods were not far-reaching enough. It is not every farmer's boy in these days who can afford to go down to Ithaca for a college education in the tilling of the soil; few of the older men care to mingle with the boys at such an institution. Even the pamphlets sent out from Geneva were not sufficient.

So when the railroads, seeking to make traffic in a dull time and to rehabilitate their branches in the farming districts, made alliance with the agricultural schools, special trains were sent out into the farming districts, and these trains carried a competent corps of instructors from the schools. Day coaches made good school-rooms for the itinerant institutions; and a baggage-car, filled with specimens of fruit and grains grown under scientific methods, was generally attached. The Western roads had used similar trains with success in building up their virgin territories. The use of the scientific schools in connection was the Eastern adaptation of the idea.

A train of this sort will "make" half a dozen towns in the course of a day. The towns are not far apart, and the schedule generally permits a stop of about an hour in each. The coming of the "farmers' special" has been thoroughly announced by handbills, posters, and the local newspapers. Whether the day be wet or fair, the appreciation of the enterprise that started the special out is sure to be manifest in a crowd that packs the day-coaches and

In the Far West the farm-train has long since come into its own

"EVEN IN NEW YORK STATE THE INTEREST IN THESE ITINERANT AGRICULTURAL SCHOOLS IS KEEN, INDEED"

INTERIOR OF THE DAIRY DEMONSTRATION CAR OF AN AGRICULTURAL TRAIN

not infrequently causes overflow meetings to be held from the rear platform of the train.

There is no cause for disheartenment in the soul of the farmer after he has been down to the train. He learns the things that his land is capable of and yet has never reared for him. Take the perennial and hardy alfalfa, for instance. Crowd into the car, where a hundred earnest men from the country-side are gathered and listening to the man from the State Agricultural College, who talks on it.

"An acre of good alfalfa," he is saying, "produces twice as much digestible nutriment as an acre of good clover. It is therefore profitable to our farmers to make every effort to establish alfalfa fields. Your climate is favorable to alfalfa, which can be grown on a variety of soils. The most favorable is a gravelly loam with a porous sub-soil. There must be drainage, fertility, lime, and inoculation. Alfalfa is a lime-loving plant, and if you have n't a limy soil, apply lime at the rate of one to two thousand pounds per acre. These figures will be given you in a pamphlet as you leave the car."

And so it goes. If the train is in one of the great fruit-growing districts of western New York, fruit is the theme of the lecturers. There is no product that the soil may give, directly or indirectly, that is too humble for the attention of the farmers' special. All the roads in Western New York have taken part in the campaign — the New York Central, the Erie, the Lehigh Valley, and the smaller roads have sent out the train over the lines, each in due turn.

The idea has gone into the Middle West and back to Pennsylvania. The Pennsylvania Railroad, which creates traffic from every conceivable source, has operated since November, 1908, four agricultural specials and two fruit-tree and shrubbery specials. The agricultural schools of the great territory it traverses have furnished the lecturers

and the material. Now it is preparing to establish down in the Eastern Shore country between the Chesapeake Bay and the Atlantic Ocean, a development farm, in which it will show the farmers of that agricultural district the greatest use that they can make of their land, the greatest results that it can be brought to yield. It has gone down into the sandy southern part of New Jersey and made the potato crop for New York and for Philadelphia into a vast yield,— a profit both for the farmer and for the railroad which has created the traffic.

The first of these development farms in the East was that established by H. B. Fullerton, under the auspices of the Long Island Railroad, at Wading River, N. Y. The Long Island possesses a territory that particularly needs development of that sort. It has a good suburban territory adjacent to New York City, but after that there is not a town of importance the entire length of its lines. There is no manufacturing of consequence out upon its line and it has been driven to the necessity of making traffic.

Fullerton's Farm is another traffic-maker by educational process. He has taken the worst of the sandy soil that makes thousands of acres at the east end of the Island, and he has created from it a model farm. The farm has had to pay its way. It has not been nurtured under any extensive appropriations from the railroad, but it has had to win its success under the same conditions that would confront the farmer who measured his capital in hundreds, rather than in thousands of dollars. It is teaching the lesson that it has sought to teach. Arid soil, on the very hearthstone of a metropolitan city, is being given over to profitable truck-farming; and the Long Island Railroad for its modest farm investment is beginning to harvest appreciable traffic returns.

The New York Central, under the guidance of its president, W. C. Brown, who is keenly interested in the revival

of farming in the East, and who personally directed the operation of the " farm specials " over its lines, has purchased two demonstration farms — one in Central, the other in Western New York. It has hired a competent farmer to have charge of them — T. E. Martin, of West Rush, who made a famous record for himself in growing 300 bushels of potatoes to the acre on land that had never before grown more than sixty. They will also serve as object lessons, and when they have been developed to their capacity, they will be sold at a far higher price than the song for which they were purchased in run-down condition. The proceeds will be turned over to the purchase and development of neglected acres in other sections along the lines of that system.

The New York Central is also making its own special development of the " farm special " idea, by taking two coaches and making them into " agricultural cars " at its West Albany shops. These cars will not run sporadically on special trains but will be in use the entire year round, being dropped at one little town after another for a day or two days or three days, in order that the farmers from the surrounding district may drop in to receive a little practical information.

Through the schools of a number of corn-growing States, into which this work has spread, boys and girls are being stimulated by prizes to plant little patches of corn. Out of each community where such an exhibit is held, ten prize-winning ears are sent to the country fair. From this the best ten ears are sent to the State fair, and interstate competition is already being developed.

There is another side to this. The railroads are making more than a new traffic for themselves, they are making a new wealth for the communities through which their rails are stretched. It has been estimated by a Pennsylvania agronomist that the value of the staple farm crops in the Keystone State in a single year exceeds $170,000,000; and that some 224,000 farmers entered into this production.

If by training and education each of these farmers can increase his yield of corn one bushel to the acre, the additional corn revenue from that one State would be $1,044,000. Further than that, he says that $780,000 would roll into the pockets of these farmers if they would choose their seed corn carefully and thus add ten kernels to each ear of corn grown by them in the course of a twelvemonth. That sort of thing looks like a coöperative benefit from almost any angle from which you may view it.

The Rock Island Railroad has begun to preach dry farming down through the Southwest. Wheat six feet in length is exhibited by that railroad in its offices throughout the East as sample of what the farmers in its territory do, under its help and supervision. That sort of thing silently makes traffic every day in the year. It is worth a dozen times what it costs the railroad.

But the railroad is not confining its efforts at making traffic to the products of the soil. What is good method with the farmer is similarly good method with the manufacturer. So you now see the railroads, east and west, working with the aid of industrial commissioners. The industrial commissioner is like a High Minister of Commerce.

Take, for instance, a typical railroad running from New York to Chicago. It has ample docks upon the sea board, extensive ramifications within the coal-mining districts; in the West it taps both the Great Lakes and the transcontinentals, which reach across the land to the Pacific. In all this district it is under hard competition, gaining its traffic — every ton of it — by the sweat of the general traffic-manager's brow. That railroad has its Industrial Commissioner, and if you are a prospective manufacturer looking for a site for a new plant, you are sure to come to him. You tell him that you want to build a factory. He tilts back his chair and looks at you easily.

"What kind of a factory?" he asks. "We 've room for 10,000 more along our rails. If it 's a silk mill I can

suggest Paterson, where the help is trained, and the dyes and raw materials handy. If you are going to turn out a steel product somewhere in the Pittsburgh district, Youngstown, Ohio, is the most economical point in the United States to-day for the turning out of finished steel. Perhaps yours is a canning factory," he laughs. "If you want to can fruit we can fix you out up in Western New York among the orchards; if you want to can tomatoes, well, sir, there is nothing like Indiana for tomatoes."

You specify your new business and its requirements in some detail. The eye of this practical Minister of Commerce illumines.

"I have the very thing you want," he says, without hesitation. "Over at W——, just half a mile above the city limits along the river. It has siding facilities." (You may be fairly certain that the siding facilities give chief access to the railroad that employs this particular Commissioner.) "And you say you want fresh water. Well, there 's five thousand gallons a day of the purest soft water in the East for you."

His eyes shine with enthusiasm. He reaches for his paper block and the next instant he is sketching the plot for you with remarkable accuracy, and with a similitude of scale. Here is the river and there is where you can build your dam. Over there is the main line of the best railroad in America (he leaves no doubt in your mind as to that); and your siding can go in there with less than a quarter of one per cent grade. The highroad is there, and close by it the trolley leading into town.

"They 've a surplus of help of the kind you want in W——," he adds. "You 'll never run short of hands there."

It sounds good, and within a week you are bound to W—— with him to meet the Secretary of the Chamber of Commerce. If things are as he has represented them to you, and your mind is unbiased, you build your factory, and the railroad picks up 200 tons a day off your siding.

That single transaction has been worth the Commissioner's salary for a year to it. There is a variety of method in making traffic.

The general passenger agent has to keep his end up. Any G. P. A. of to-day found entertaining the old-fashioned idea that the traffic that flows of its own volition up to the ticket-wickets is going to be sufficient to satisfy his employers is out of present-day development. The general passenger agent who gets patted on the back nowadays is the man who goes to the president in a dull season with a sheet showing gains over a preceding busy season. He may have to bring water from stones to increase that tide of traffic, but it must be increased. There are no two ways about what is expected of him.

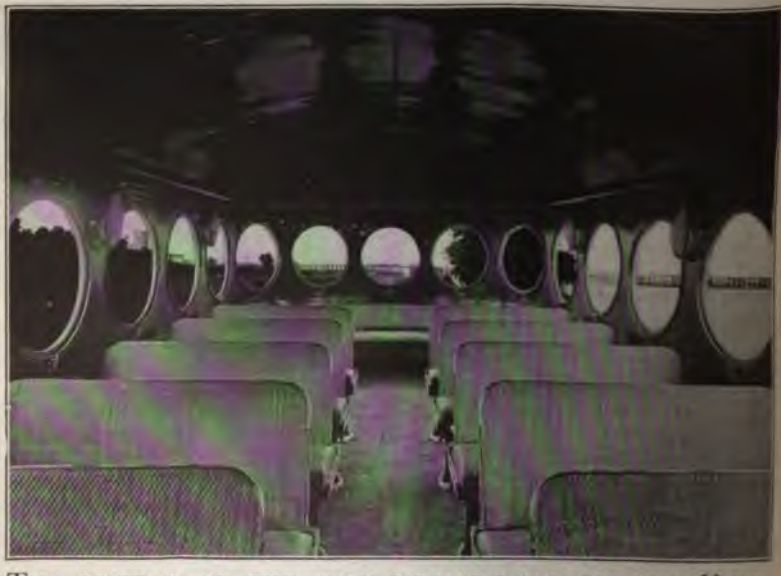
So he gets out, like the traffic people from the freight end of the railroad, and he keeps in constant touch with his territory, with the towns along the line and the agents who are working under him. If he is instrumental in locating a big convention at some point where his line will receive the lion's share of the business, that is a good trick and worth while. A lively convention will do a lot toward bracing up a weak passenger sheet in some dull month.

One railroad reaching out of New York into the mountains at the northeastern corner of that State and losing itself at some obscure town, a railroad without valuable connections and ramifications, has made its passenger business a little gold-mine by scientific nurturing. It sent its passenger representatives up into the country towns, and they sought to improve conditions of every sort there. They started agitation for better roads from the railroad into the uplands where city folk were prone to wander; they helped the boarding-house landlord and the country hotel-keeper to bring their facilities up to attractive standards. In some cases they induced capital to come in and build new hotels. In every case they offered free

THE FAMOUS THOMAS VIADUCT, ON THE BALTIMORE & OHIO A
RELAY, MD., BUILT BY B. H. LATROBE IN 1835, AND STILL IN US

THE HISTORIC STARUCCA VIADUCT UPON THE ERIE

THE CYLINDERS OF THE DELAWARE & HUDSON MALLET



THE INTERIOR OF THIS GASOLINE-MOTOR-CAR ON THE UNION PACIFIC PRESENTS A MOST UNUSUAL EFFECT, YET A MAXIMUM OF VIEW OF THE OUTER WORLD

ce in the railroad's summer resort literature. Under ngle general passenger agent pursuing such a campaign laggingly the passenger receipts of that small railroad reased 125 per cent in eight years!

Take the case of Atlantic City. That town used to be a lection of wooden hotels, set along a sandy pleasant, ch, which were content with six or eight weeks of d business in midsummer. The railroads that stretched ir rails down to it registered good earnings during that season, and they had to put in extensive plants to idle that six or eight weeks of heavy traffic. The exsive — and expensive — plants were idle a great part the year, and there was a lot of capital wasted. The nagers of the railroads told the summer hotel proetors that, and asked why beach property should be a ing investment ten months out of the year. That was ew sort of proposition for a summer resort hotel proetor but it seemed sound argument and the hotels ended their seasons at either end. They combined with railroads in making attractive special rates for these ler parts of the season, and before long the spring was l nigh as popular and as profitable as midsummer.

Folk came over from Philadelphia and Pittsburgh, and from Baltimore and Washington, to spend their sumrs at Atlantic City, and the scientific business-making re created a fashionable season for Northerners from ster forward. The building of wooden hotels ceased, l fireproof structures of brick and stone, steel and conte, began to rise along the beach. Capital ceased to idle at Atlantic City. The hotels began to keep open year around, and the scientific method of the biggest the railroads had been so effectual that it built a millionlar bridge across the Delaware at Philadelphia to idle through traffic down to Atlantic City.

Still the railroads worked in harmony with the hotels, l the fashionable season began at Christmas instead of ster. Before long they will make the fall fashionable,

and then the hotels will be crowded all the year round. When there is a lull in the season they bring on half a dozen conventions and fill the trains and the hotels with the delegates. That Atlantic City plant does not lie idle much of the time. There are nearly 800 hotels there to-day — more than fifty of them huge structures — and on a busy day 300,000 people are along the famous boardwalk above the beach. In dull days the big hotels are comfortably filled. The hotel men have made fortunes, the railroads have added millions of dollars to their passenger earnings because of Atlantic City.

There you have the best example of this new creed of the practical railroader — making traffic. It is not a lost example. Across the land every city and town, every resort, from the haughty spa with a cluster of brilliant hotels down to the humblest inn that ever cuddled by the shore of a silvery lake, is taking notice of the creed. The farmer is bending himself to increase the yield of his land, while the railroad reaps a benefit. The marketman from town is reaching out for better sources for his needs; the railroad helps him and reaps a benefit. The resort hotel arranges a joint rate and ticket with the railroad, which covers both transportation and board for a "week-end" in the dull season, and the passenger receipts are swelled in some degree.

That is what the railroader calls making traffic.

CHAPTER XXIII

THE EXPRESS SERVICE AND THE RAILROAD MAIL

DEVELOPMENT OF EXPRESS BUSINESS — RAILROAD CONDUCTORS THE FIRST MAIL AND EXPRESS MESSENGERS — WILLIAM F. HARNDEN'S EXPRESS SERVICE — POSTAGE RATES — ESTABLISHMENT AND ORGANIZATION OF GREAT EXPRESS COMPANIES — COLLECTION AND DISTRIBUTION OF EXPRESS MATTER — RELATION BETWEEN EXPRESS COMPANIES AND RAILROADS — BEGINNINGS OF POST-OFFICE DEPARTMENT — STATISTICS — RAILROAD MAIL SERVICE — NEWSPAPER DELIVERY — HANDLING OF MAIL MATTER — GROWTH OF THE SERVICE.

WHILE the great transportation functions of the railroad are devoted to the comparatively simple problems of soliciting and carrying both passengers and freight in ordinary channels, there are, nevertheless, special functions of the carrier that demand some slight attention in passing. These functions might quite properly be known as the by-products of transportation. The most important of them are the carrying of small packages of rather greater value than that the railroad ordinarily gives to the goods that it handles in its own cars, and the carrying of letters and periodicals. These last two are handled as a monopoly by the Federal Government, which also competes with a half-dozen big private corporations in the transportation of merchandise in small individual lots. The Government calls its service the railroad mail and it is the bone and sinew of the Post-office Department. The private corporations, creeping in upon what is also generally a government monopolistic privilege in other lands, handle what they are pleased to call the express business. Their business has grown up alongside of that of the United States Government and

ıe development of the two has run in very similar channels.

The express business, like a good many other big businesses, began in rather simple fashion. Before the railroad came into being, the citizens in the different towns of the young and rather sprawling nation along the Atlantic seaboard found it a difficult problem to communicate with one another. They used to entrust letters and valuable packages to the drivers of stage-coaches or to the captains of coasting-vessels. If the drivers or the captains remembered the letter-packet or the package, it was safely delivered. If they forgot —! So, when the railroad came and drove the old stage-lines out of business, the conductors of the trains were asked to accept this side responsibility as an informal part of their work. As long as this messenger function remained a slight thing, the railroads paid little attention to the practice, but after a while, the conductors got to paying more attention to it than to running the trains and the railroads finally had to stop it.

In the golden age when the conductor's job was developing this valuable perquisite, William F. Harnden had charge of a passenger train on the old Boston & Worcester Railroad — a part of the Boston & Albany, which, in turn, is a part of the New York Central lines. Harnden had entered railroad service in 1834, when he was but twenty-two years old. He foresaw the day when the railroads would have to put a stop to their conductors acting as messengers for the general public, and so, a few years after he had gone to work for the Boston & Worcester, he went to the superintendent of that highly prosperous little line, as well as to the highly prosperous Boston & Providence, and asked for an exclusive contract for an express service over it as part of a through route between New York and Boston. So it came about that in a Bos-

ton newspaper of February 23, 1839, the following advertisement appeared:

"Boston and New York Express Car. William F. Harnden has made arrangements with the Providence railroad and the New York Boat company to run a car through from Boston to New York and vice-versa four times a week commencing Monday, March 4. He will accompany the car himself, take care of all small packages that may be entrusted to his care and see them safely delivered. All packages must be sent to his office, 9 Court street, Boston; or 1 Wall street, New York."

That "car" was a flight of Harnden's imagination, because for several months a valise sufficed to carry all the packages that were entrusted to his care. But he progressed, and after a little time he found it necessary to engage his brother and still another man to act as messengers with him. The following year he extended his express service to Philadelphia and to Europe. You may be sure that the success of Harnden's experiment was being noticed by the thrifty New Englanders. Alvin Adams, who had been in the grocery commission business up in Vermont, established an express service of his own in 1840, which in due course of time was to become the Adams Express Company. It is possible that there might have been to-day a Harnden Express Company as well, if America's pioneer expressman had not died six years after establishing his interesting venture.

After Alvin Adams, came a host of express services springing up all over the eastern end of the United States. Henry Wells, who had been the associate of Harnden in the development of his business, formed a partnership with one George Pomeroy for a service between Albany and Buffalo. William G. Fargo, the freight-agent for the one-time Albany and Syracuse Railroad, was the freight-agent for Pomeroy and Wells at Buffalo in 1842. Wells and Fargo eventually got together, and in the

throbbing days of the late forties and the fifties, Wells, Fargo & Co. became an express service of magnitude, a concern not to be lightly reckoned with.

Strangely enough, the express companies came to their first prosperity through the thing that they are now forbidden to carry — letters. For in the early forties the United States Post-office Department demanded six cents for carrying a letter thirty miles, eight cents for sixty miles, ten cents for one hundred miles — the ratio steadily progressing until twenty-five cents was charged for 450 miles. Those rates had been in effect since the department was first established, and the service was fearfully slow, and untrustworthy into the bargain. The new express companies took advantage of their opportunity and — to cite a single instance — they would carry a letter from Buffalo to New York for six cents, while the Government charged twenty-five cents for a similar, but an inferior service.

In 1850 the express services were beginning to be merged — Livingston & Company and Wells & Company had already formed the American Express Company. Four years later, Adams & Company, Harnden & Company, and some of the smaller express services united in the formation of the Adams Express Company,— and in that year the minstrel men began to ask the question: "For whom was Eve made?" The United States Express Company was also organized in 1854, and all this while Wells, Fargo & Company were forming history for themselves in the Far West — carrying mail out to the gold miners and their precious dust east in return.

By the beginning of the Civil War, there was a well established business, a business established with admirable foresight. Such men as Adams, Wells and Fargo, and Benjamin F. Cheney, one of the founders of the American Express Company, said that the express business should be kept within narrow limits — so within narrow limits it has been kept, and to-day when Harnden's suitcase has devel-

A PORTION OF THE GREAT DOUBLE-TRACK SUSQUEHANNA RIVER BRIDGE OF THE

"IN SUMMER THE BRAKEMEN HAVE PLEASANT ENOUGH TIMES OF RAILROADING"

A FAMOUS CANTILEVER RAPIDLY DISAPPEARING — THE SUBSTITUTION OF A NEW KENTUCKY RIVER BRIDGE FOR THE OLD, ON THE QUEEN & CRESCENT SYSTEM

oped into a business paying luscious dividends on more than a hundred million dollars of capital stock, there are five great companies: the American Express Company, the Adams Express Company, the Wells, Fargo Express Company, the United States Express Company, and the National Express Company. The interests of these companies are closely interwoven — for instance: while the National Express Company is operated as a separate business, it is absolutely controlled by the American Express Company. In addition to this Big Five, there is a cluster of smaller companies, such as the Great Northern Express Company, of J. J. Hill's system, the Southern Express Company, the Long Island Express Co., and two thriving carriers in the Dominion of Canada. These in turn are more or less closely affiliated with the larger companies.

The express companies no longer force a man to bring his shipment to their offices. In every considerable town, there are whole fleets of wagons that reach to the outermost limits, both for collection and for distribution. In this service the automobile truck has begun readily to displace the older type of horse and wagon. The wagon service brings the express package, no matter how small or how large, to a central distributing depot, where all are gathered together and sent, in through railroad cars, to their destinations, being handled very largely as we have seen the L. C. L. freight handled in the great transfer houses of the railroads. The express company guarantees the safe delivery of the package that is entrusted to its care. This package may be of the smallest sort imaginable, or it may be a consignment of a million dollars in specie. In either case, the express company still accepts the entire responsibility.

If there are whole brigades of delivery wagons in the cities there are also whole platoons of special cars owned by the railroads and dedicated to the express service. This brings us to the crux of the express question — its

relations to the railroad. These are embraced in voluminous contracts and subcontracts — which are generally placed among the secret archives of all the companies that subscribe to them. The Interstate Commerce Commission, at Washington, has had, however, access to most of these contracts and of them it has said:

"The contract between an express company and a railroad company usually provides that the express company shall have the exclusive right to operate upon the lines named for a definite term of years; that all matter carried on passenger trains, except personal baggage, corpses, milk cans, dogs, and certain other commodities, shall be turned over by the railroad company to the express company; that the railroad company shall transport to and from all points on its lines all matter in charge of the express company; that special or exclusive express trains shall be provided by the railroad company when warranted by the volume of express traffic; that the railroad company shall furnish the necessary cars, keep them in good repair, furnish light and heat and carry the messengers of the express company as well as all necessary equipment; that the railroad company shall furnish such room in all its depots and stations as may be necessary for the loading, unloading, and storing of express matter; that the express company may employ during the pleasure of the railway any of the agents of the latter as express agents and may employ the train baggage-men as its messengers.

"The express company, on its part, agrees to pay a fixed per cent of its gross receipts from handling express matter; to charge no rate at less than an agreed per cent of the freight rates on the same commodity — usually one hundred and fifty per cent; to handle, free of charge, money, bonds, valuables, and ordinary express matter of the railway."

The railroad mail service is, in many ways, closely analogous to that of the express service. To it also, are devoted whole platoons and brigades of especially equipped cars, and it comes under the direction of the capable traffic officers of a great government department.

The Post-office Department is practically as old as the nation itself. For it was away back in November, 1776,

that Ebenezer Hazard, who had been appointed Postmaster General to the Continental Congress, filed a memorandum of gentle complaint because of the long distances he was compelled to travel to keep pace with the wanderings of the Continental Army. But it was not until George Washington had become President of the United States, in April, 1789, that the Post-office Department came into any real semblance of organization. Samuel Osgood, of Massachusetts, was the man to whom was given the task of making a real business out of what had once been a haphazard courtesy of the past of stage-drivers and ships' captains. Some men had made individual businesses out of the management of stage-routes — in fact, Benjamin Franklin was an early postman. But the United States Government from the beginning created the mail service as a monopoly for itself — following the rule of other nations.

In 1789 the Post-office Department was a crude enough affair. The Postmaster General had but one clerk, there were but 75 post-offices and 1,875 miles of post-roads in the whole country. In the first year of the department's activities the cost of mail transportation is given as being $22,081, with the total revenue $37,935. The total expenditures of the department that year were $32,140, leaving a surplus for the twelvemonth of $5,795, a somewhat better showing than has been made in some years since that time.

The report of the Post-office Department for the year ending June 30, 1910, lies before us as we write this chapter. It tells the graphic growth of a great business in one hundred and twenty years. For in this last twelvemonth the receipts were $224,128,657 — a really vast sum compared with that modest $37,935 for 1789–90. The expenditures for this year ending June 30, 1910, were even higher — $229,977,224 — leaving a deficit of $5,848,567. The Postmaster General has asserted, however, that he will have succeeded in turning that loss

into a slight profit for the year ending June 30, 1911. These figures do not alone show the growth of the mail service of a great land that has become entirely dependent upon this great function of its business and social life. Think of the 75 post-offices of 1789, compared with the 59,580 offices of 1910 — and that because of the marvelous development of the rural free delivery during the past ten or twelve years, a decrease from the high-water mark of 76,688 in 1900. Figures are sometimes impressive and the statistics of the Post-office Department show that 78,557 postmasters, clerks, and carriers give the major portion of their time to its service. In addition to these, those same statistics enumerate 40,997 rural delivery carriers, who bring the entire post-office force up to the astounding total of 119,554 men and women.

Without the railroad the Post-office Department could not have come to its present great development as one of the chief arms of government activity. The postal service is an interesting adjunct of the railroad; the railroad is a vital factor in the successful conduct and development of the postal service. Away back in 1836, Postmaster General Barry, in his annual report, spoke of the rapid multiplication of railroads in all parts of the country and asked if it was not worth while to secure the transportation of mail upon them. He added:

"Already have the railroads between French Town, in Maryland, and New Castle, in Delaware, and between Camden and South Amboy, in New Jersey, afforded great and important facilities to the transportation of the great Eastern Mail."

As General Barry wrote, the Baltimore & Ohio was spinning its extension lines from Baltimore to Washington, and he expressed an opinion that with that line a through mail service from New York to Washington might be accomplished in sixteen hours. That service is now made between those cities in five hours. General

appeal must have brought fruit, for Congress,
7, 1838, passed an act approving every railroad
Jnited States as a post-route.
railroads accepted this responsibility with alacrity.
ıltimore & Ohio equipped compartments in bag-
rs running between Baltimore and Washington,
were kept tightly locked and to which only the
sters of those two cities had access. Still the early
s of handling merchandise of every sort were crude
was not until the days of the Civil War that the
l mail service began to attain anything like its pres-
cision and despatch. Most great organisms are
trace their development to the brilliancy or the
ion of one man or a group of men, and the rail-
ail service has been no exception to that rule.
A. Davis, a clerk in the post-office at St. Joseph,
ri, in 1862, conceived the idea that railroad mail
e assorted on the cars before it reached St. Joseph.
e days, St. Joseph was a pretty important sort of
. The overland mail started west from there, and
thought that if it could be at least partly assorted
it reached St. Joseph, there would be no delay in
overland. The Post-office Department encour-
im and he began what was destined to become the
nportant and interesting function of the railroad
rvice.
he same years that Davis was studying out postal
ns at St. Joseph, Col. G. B. Armstrong was as-
postmaster at Chicago. He was asked by Post-
General Montgomery Blair, of President Lincoln's
t, to undertake the development of the railroad
rvice. He accepted the task August 31, 1864, and
later was made General Railway Mail Superin-
, a position which he held until 1871, when he was
led to retire because of ill health. Col. George S.
of Illinois, succeeded him, and to Col. Bangs was
he opportunity of the third great development in

the railroad mail service. In his report for the year 1874 he discussed the possibilities of establishing a fast and exclusive mail train between the two great postal centres of the land — New York and Chicago. To quote from Colonel Bangs' report:

"This train is to be under the control of the department so far as it is necessary for the purpose designed, and to run the distance in about twenty-four hours. It is conceded by railroad officials that this can be done. The importance of a line like this cannot be overestimated. It would reduce the actual time of mail between the East and the West from twelve to twenty-four hours. As it would necessarily be established on one or more of the trunk lines having an extended system of connections, its benefit would be in no case confined, but extended through all parts of the country alike."

Postmaster General Jewell liked Col. Bangs' idea and told him to arrange with the Lake Shore Railroad and the New York Central & Hudson River Railroad for a fast mail train to leave New York at four o'clock in the morning and make Chicago in twenty-four hours. But the Post-office Department, while it might grandly order fast mail trains into service, had no appropriation from which to pay for them. Nevertheless, Col. Bangs appealed to the older Vanderbilt, owner of both the New York Central and Lake Shore Railroads. Commodore Vanderbilt was not a sentimentalist. He had little use for men who came to him with risky propositions and empty pocketbooks. Nevertheless, the mail train idea appealed to the old railroader, and he turned to his son, William H. Vanderbilt, and asked him what he thought of the idea. The younger Vanderbilt suggested building the special cars needed for this service and placing the train in operation, with hopes of remuneration by the following Congress. He felt that the new trains would instantly become so popular as to compel Congress to provide for their up-keep.

"If you want to do this, go ahead," said Commodore Vanderbilt, "but I know the Post-office Department, and you will, too, within a year."

William H. Vanderbilt went ahead. He constructed and placed in service such trains — of glittering white and gold — as the railroad had never seen. Nightly they made their spectacular run between New York and Chicago with clock-work regularity. They never missed connections. The Pennsylvania Railroad quickly followed the example of its traditional rival. Within a half-year the United States had such a mail service as it had never dreamed of possessing, a mail service a quarter of a century ahead of any other nation in the world.

And yet Congress did the very thing that the sagacious old Commodore Vanderbilt had predicted. It absolutely refused to pay for the fast mail trains, and they were taken out of service. There was another factor in the situation, however, and that always a lively factor — the public. When the man out in Sioux City found that his mail was again taking eighteen additional hours to reach him from New York, he rose up in all the fulness of upstrung wrath and let his Congressman hear from him. And he was only one of tens of thousands whose business comfort had been heightened, quite imperceptibly, by the new trains, and upset very perceptibly by their withdrawal. They were returned to service in 1877, and have since become so recognized and useful a function of the mail service that it would be a brash Congress or Postmaster General who would even attempt to tinker with them.

Sometimes you brush elbows with the railroad mail service. You notice perhaps, the big heavy car up forward in the long train, with its open door and its gallows-like crane for snatching mail-bags, at cross-road stations, where the through train does not even deign to slacken speed. If you have had an important and delayed letter

to post, you may have breathed your little prayer of thanks to the railroad mail because you are able to drop it into the slot of a car that stood, that was halted for an impatient minute or two in its race overland. But these are hardly more than superficialities of the service. If you wish to come closer to its heart, present yourself sometimes just before dawn at one of the great railroad terminals of a really metropolitan city. You had better present yourself in spirit and not in flesh, because this busy time — when most honest men are asleep — is not a time when visitors are welcomed. The Government is singularly diffident about showing the inner workings of its Post-office Department.

But these inner workings are alive and alert at three o'clock of the morning that you come to the platform sheds of the big terminal — you can see the shadowy outline of the darkened building itself rising up behind you. Most of its platforms which by day are constant and brisk little highways, are also darkened. The long files of empty coaches that line these platforms reflect in their many windows the signal lights of the outer yard. Now and again you catch the flicker of a pointed yellow light against the background of blackness — the bobbing of a watchman's lantern as he sees that all is well in the few hours of comparative quiet that come to this great terminal.

This one train platform is alert and alive — brilliant under the incandescence of electricity. A brigade of shirt-sleeved men line it, while to its outer edge one great wagon after another — each showing the red, white, and blue of government service under the reflections of the arcs — comes rolling up, with a fearful clatter over the rough pavement of the station yard. From the cavernous recesses of these great wagons their stores are poured forth — dozens and dozens of mail sacks of leather and canvas, each tagged and directed with absolute accuracy.

'he grimy granite bulk of the general post-office is a
ce half-dozen blocks away from this terminal — an
span for each of the great mail-wagons. Into that
:ral post-office the mail — letters, newspapers, pack-
, all of inconceivable variety — has been pouring at
l-tide ever since the close of business nine hours be-
. The carriers with their heavy pouches began this
; wagons bringing their contribution greatly swelled
From the nearer stations the mail came, silent and
en, through the giant pneumatic tubes that reach out
ı the general post-office, under city streets, like great
·ies. Underneath the ghastly green mercury lamps of
distributing floor of the general post-office, the first
ı were taken toward separating the flood. Expert
-clerks, working under tremendous tension, made a
h classification of all that come under their trained
:rs — sometimes by counties, again by States, or even
oup of States. One great subdivision was transcon-
ıtal and transpacific. This train with its close con-
ions on the Western lines will reach San Francisco
in time to catch there a big, red-funnelled steamship
ıt to depart for Yokohama and Hong Kong. At
ıg Kong the red-funnelled boat will connect with a
: O. steamer whose screws will hardly cease revolving
. she reaches Calcutta. The railroad mail service is
ing that reaches much farther than the rights-of-way
ıe railroads themselves.

here are seven cars in this train — five cars for the
al service and two chartered by the morning news-
:rs. There are no coaches. Now and then one of
e flyers will deign to carry a single sleeper, but such
.e exception. The fast mail does not stop to quibble
such trifles as passengers. It even turns its shoulders
ı the express companies — they have their own fast
ial trains across the continent.

'he last of the mail-wagons has delivered its valuable

load to the cars. The final newspaper wagon comes dashing up to the platform — its horses a-froth and its driver on the edge of profanity.

"Here's the firsts," he yells. "Big fire down the water-front and they wanted to make the edition with it. We were three minutes late."

Three minutes late! Seventeen minutes ago the last of the smoking-hot forms came from that newspaper's stereotyping rooms and here are the first ten thousand copies of the morning's run — fresh and damp smelling of the forest. Before the driver began his hurried explanation of delay, the copies were being thrown into the last car. He had hardly finished before a big bell, high-hung somewhere in the invisible blackness, speaks its one brief note of authority; lanterns are raised alongside the full length of the train — the seven big cars are softly getting into motion. And before this train is fully in motion the newspaper's messengers are busy with the papers that have been thrown in at the open door; before it has bumped its way over the wide-spreading "throat" at the entrance of the terminal, they are bringing the first semblance of order out of the miniature mountain of newspapers piled high on the car floor.

Chaos, did we say? Well, hardly that. The circulation manager of the metropolitan morning newspaper has been called a "field marshal of the empire of print," and field marshals incline to order rather than to chaos. It is less than seventeen minutes from the first of that torrent of newspapers pouring from the hopper of the grinding press, yet here they are, each in an accurate bundle of not more than two hundred and fifty copies, and accurately tagged. The label of each bundle bears in big clear letters the news company or dealer to whom it is consigned, the town, the railroad and its connections. There is not much chance for errors here.

As the newspaper messengers begin to arrange their stock — the papers for the nearest towns on top so that

hey may be most easily reached, to be thrown off while t is still dusk, so that Mr. Early Riser may read his avorite metropolitan journal as he sips his breakfast offee — so are the mail-clerks in the cars ahead bending o their tasks. Roundabout them are rows of pouches eld in iron frames, with their hungry throats held wide pen, and infinite racks of small pigeon-holes — the same ind that you remember in the up-country post-offices. When the pouches first come into the car they are opened nd their contents " dumped-up," to use the parlance of he service, upon the shelf-like tables that run the length f the place. The next process is " facing-up "— bring- ng addressed sides of all the matter uppermost for fa- ility in distribution. And after that the distribution self — no easy matter when all the world is constantly riting to all the world, and the criss-cross currents are all ut innumerable.

So come all classes of mail to these swift-flying cars — tters, newspapers, packages, the specially protected reg- tered mail,— and for all of these classes the apparently idless sorting goes steadily forward, while the train unds sharp curves and sends the ordinarily sure-footed erks clutching handrails for balance, under the dead ow of acetylene, holding each separate mail-piece for a action of a second — sometimes longer if it be a sticker " in the chirography or the detail of its address - and then shooting it into the proper pigeon-hole or pen-mouthed pouch. Some of these cars are destined r cities or States or groups of States — the wheels under ie of them are not going to cease revolving for any ngth of time until it stands on the long Mole, opposite an Francisco, and the through pouches, with the British at-of-arms and the meaningful " G. R." stamped upon em, are being shipped aboard the red-funnelled steam- ip which is to carry them on the last leg of their long urney over two seas and a broad continent, from Lon- on to Hong Kong.

These trains are no longer novel on the modern railroad. They are established features of the train service. From New York City goes forward one-sixth of all the mail matter originating in the United States. The aggregate circulation of all the New York morning newspapers is somewhat larger than the aggregate circulation of the morning newspapers of the other cities of the country, so from New York there goes forth between midnight and dawn a flotilla of special mail and newspaper trains. Two of the fastest of these start from the Grand Central Station. The "Boston Special" of the New York, New Haven & Hartford leaves that spacious terminal at just 2:10 A. M., no matter what desperate excuses may be telephoned at the last moment by some circulation manager who is confronted by a disabled press, or some such disaster. It slips through the suburban territory without halting — the nearby commuters are served with their papers and their mail by the early morning locals. Bridgeport, at 3:31 A. M., is the first halt; New Haven, at 3:52, the second. At New Haven, the papers for Hartford, Springfield, and the whole Connecticut valley country are thrown off. At New London, which is reached at 4:53 A. M., go the papers for Norwich, Worcester, Newport, and New Bedford. One more halt, at Providence, and the train, running as fast as the fastest of New Haven flyers, is at the South Station, Boston — at just 7:20 o'clock. A Boston & Maine flyer, taking mail and newspapers away up the coast through three States, leaves the North Station at 8:01 A. M., and so there follows a quick transfer of mail and newspapers through the twisting streets of the Hub.

The other early morning flyer leaves the Grand Central at 3:05 o'clock, and it makes its course over the main stem of the New York Central Lines. It reaches Albany at 6:30 o'clock and not only distributes there for Western Massachusetts and Vermont, the upper Hudson Valley and the Lake Champlain territory north to Montreal, but

overhauls a passenger train that left New York a little after midnight. It continues its course through the heart of the Empire State — reaching Syracuse at 10:05 A. M. and Rochester at 11:47 A. M. At Buffalo, which is reached at 1:20 P. M., there are important connections for the West and Southwest, and the Chicago letters in that grimy train are going out on the first delivery from the Chicago post-office the next morning.

The Pennsylvania hauls two great trains — built up of mail sections from its new terminal on Manhattan Island, which has a great post-office in process of growth, built over a portion of its platform tracks, and newspaper sections from the old Jersey terminal, which is still most convenient to a majority of the metropolitan papers. The first of these trains is bound for the South and the Southwest. It leaves New York at 2:20 A. M., passes Philadelphia at 4:25, and steams into Baltimore at 6:40 A. M. Another hour sees it in Washington and transferring its load to the mail-trains that are about to start for the long journey to Atlanta and New Orleans. A New Yorker sojourning for a part of the winter at Palm Beach, Florida, can be sure of having his favorite Sunday paper not later than Tuesday morning.

The second Pennsylvania train leaves thirty minutes later and follows the main line of that much-travelled highway all the way to Pittsburgh, which it reaches just at noon. Other railroads out of New York start fast newspaper and mail trains just before dawn and combine regular passenger facilities with them — the Lehigh Valley despatching a flyer at 2:00 o'clock from the old Pennsylvania terminal in Jersey City for the populous northeastern corner of Pennsylvania and the so-called Southern Tier of New York State. The Lackawanna reaches a somewhat similar territory by its fast express, which leaves Hoboken at 2:30 o'clock.

A similar cluster of mail and newspaper flyers starts out of Chicago early each morning — east over the Lake

Shore, the Michigan Central, and the Pennsylvania, south over the Monon and the Illinois Central, and west and northwest over the Northwestern, the Rock Island, and the Santa Fe. Other great cities follow the same programme in lesser scale — there are many important fast-mail trains that make their departures from initial terminals throughout all the daylight hours and late into the evening. A regiment of mail-cars make their way over the face of the land on fast through expresses of every sort. The postal service is a business of magnitude within itself.

The Postmaster General's report for the year ending June 30, 1910, gives a clear conception of its magnitude. He showed then that there were 176 full railroad post-office lines, manned by 1,736 crews of 8,332 clerks. There were also 1,392 compartment railroad post-office lines — lines in which a portion of a baggage or smoking-car is partitioned for the sole use of the postal service — manned by 4,085 crews of 5,407 clerks, 18 electric car lines with 20 crews and 22 clerks, and 55 steamboat lines with 98 crews and 86 clerks. Of the cars built for the exclusive use of the railroad mail service, 1,114 were in use and 206 held in reserve, while 3,208 of the compartment cars were in use, 559 of these being held in reserve. In addition, the Post-office Department operates 25 trolley mail-cars.

Great progress has been made in the substitution of steel mail-cars for wooden ones — a real step forward when one pauses to consider the dangerous position in which the mail-cars are placed in most trains. The records of the Post-office Department are filled with stories of heroism on the part of mail-clerks in saving, both the extremely valuable merchandise that is given to their care, and vastly more valuable human lives. The list of the post-office employees who have met death while on duty in the railroad mail service is not a short one.

But the railroads are coöperating with the Government

inest type of steel cars to its mail service,—
are already in use on the Pennsylvania sys-
we stated at the outset of this chapter, the
of Uncle Sam's mail is no slight function
n railroad. The big operating men across
onstantly bending their heads with those of
officials toward the betterment of that

CHAPTER XXIV

THE MECHANICAL DEPARTMENTS

CARE AND REPAIR OF CARS AND ENGINES — THE LOCOMOTIVE CLEANED AND INSPECTED AFTER EACH LONG JOURNEY — FREQUENT VISITS OF ENGINES TO THE SHOPS AND FOUNDRIES AT ALTOONA — THE TABLE FOR TESTING THE POWER AND SPEED OF LOCOMOTIVES — THE CAR SHOPS — STEEL CARS BEGINNING TO SUPERSEDE WOODEN ONES — PAINTING A FREIGHT CAR — LACK OF METHOD IN EARLY REPAIR SHOPS — SEARCH FOR FLAWS IN WHEELS.

TO care for its rolling-stock the railroad creates two distinct functions of its business. All the care of its permanent way, including tracks, tunnels, bridges, comes under the control of the Maintenance Way Department. Similarly, the Mechanical Department assumes control of the cars and engines, sees to it that each is maintained to its fullest efficiency, both by care in daily service and by certain visits to the shops at regular intervals, for repairs, reconstruction, and painting.

To do all this requires a large plant, both in buildings and machinery. It is distributed at every important point along the railroad. At terminal and operating points, roundhouse facilities of greater or less extent are sure to be located, and at the headquarters of each division these are generally expanded into shops for the making of light repairs and to avoid handling crippled equipment for any great distance. One large shop plant is apt to suffice the average railroad for the heavy repair work. If the road stretch to any extraordinary length, even this feature is apt to be duplicated in order to concentrate this repair work as far as possible.

All this concerns the care and repair of the locomotive — which the railroader quickly groups under the title

"motive-power." To care for the engines while they are in use out upon the line, to see to it that engineers and firemen alike handle these mechanisms with economy and skill, is a responsibility that is placed upon the road foreman of engines of each division. He has supervision over smaller roundhouses but at any of the larger of these structures there is a roundhouse foreman in direct charge. The railroad long ago learned that its best economy rested in having plenty of executive control. That has come to be one of the maxims of the business.

There is a master mechanic in charge of the division shops and in many cases he has authority over the road foreman of engines and the roundhouse foremen. Then under him he has his various assistants, forming a working force not at all unlike that of the average iron-working shop. All this organism is gathered together under a superintendent of motive power, who in turn may report to a general mechanical superintendent. This official answers only to the general manager, or, in some cases, to a vice-president to whom these functions of the care of the railroad are delegated.

The proposition of the cars is generally treated quite apart from that of the locomotive, and separate shops under the direction of a master car-builder and his assistants are located at a few points upon the system, where they may be of fairly easy access. Rough repairs (the car-builders term these "light" repairs) to cars are carried forth at each division yard. This work is almost entirely confined to the freight equipment, and a good part of it goes upon "foreign" cars — cars that do not belong at all to the railroad making the repairs.

This feature of the repair work is a direct result of an elaborate system of interchange in freight equipment upon American railroads, in order to prevent the breaking of bulk in the shipment of merchandise from one line to another. Cars will break down when they are many hundreds of miles away from home, and the railroad upon

which they are operating at the time carts them to the nearest temporary repair yard or to its own shops, makes the necessary repairs, and charges for them in accordance with a scale prepared by the national association of Master Car-Builders. This necessitates a vast deal of bookkeeping and is only one of the many complications brought about by our extensive plan of railroading in America.

The railroad will probably build the greater part of its freight equipment, although in these days of the supplanting of wood by steel in car-construction the companies are apt to stand appalled at the cost of the steel working machinery, and to buy their cars direct from the manufacturers very much as they purchase their locomotives. Passenger equipment is almost invariably secured in this way. It is a big railroad indeed that seeks to construct for itself the huge travelling palaces that the passenger of to-day has come to demand for his comfort. The repairing and the painting of these elaborate vehicles is enough of a proposition in itself.

To begin at the beginning, one first comes in contact with the mechanical department as it comes into constant contact with the operation of the railroad. This is the more quickly observed at the roundhouses, those great circular structures that are a feature of the railroad section of every important town. In England the "engine sheds," as they are there known, are simple enough structures, housing a series of parallel tracks, which are served by either a transfer table or switches. Such a plan is pursued in this country only where space is at a premium — as in the heart of some great city where realty is exceedingly high-priced; for the heads of our railroads have held tenaciously to the easily operated turntable and roundhouse scheme. The table, generally driven by electricity or a small dummy engine, forms the centre, the roundhouse a segment of the entire rim of the wheel. The great advantage of its simple design lies in the fact that it

TRIPLE-PHASE ALTERNATING-CURRENT LOCOMOTIVE BUILT BY THE GENERAL ELECTRIC CO. FOR USE IN THE CASCADE TUNNEL, OF THE GREAT NORTHERN RAILWAY

HEAVY SERVICE, ALTERNATING AND DIRECT CURRENT FREIGHT LOCOMOTIVE BUILT BY THE WESTINGHOUSE COMPANY FOR THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD

THE MONOROAD IN PRACTICAL USE FOR CARRYING PASSENGERS AT CITY ISLAND, NEW YORK

THE CIGAR-SHAPED CAR OF THE MONOROAD

is instantly possible to get at any one of the fifty or more locomotives that it houses. It is this feature that has endeared it to the railroad man for many years.

The locomotive that hauls the train goes to its "stall" in the roundhouse directly after its work is done. Its crews, having finished their run, desert it for the time being, and it comes within the charge of the roundhouse foreman and his "hostlers." These old terms are reminiscent of the days when the roundhouse was a real stable and its denizens flesh and blood horses. Now the denizens of the roundhouse are iron horses, and in their great size as they rest within their house they are indicative of the progress that has been made in the design and construction of railroad equipment.

On the way to the roundhouse, possibly on the way from it (the practice varies on different railroads) the engine will stop at the ash-pit. It will have its fires cleaned in a long pit that runs underneath a section of track, and then pass on to the coaling-shed. The long pit at some points is filled with iron buckets that run on wheels into which the ashes are dumped and these are emptied by overhead crane apparatus into a nearby line of empty gondolas, ready to be taken away to be disposed of.

At the coaling shed the tender is filled, some twelve or fifteen tons being required if the engine is large; the water-spout fills the capacious tanks, while the hostlers take good care to see that the sand-box is filled, as a precaution against slipping on the next steep grade. Then on to the turntable and the waiting stall, until ready to go out again upon the regular service or extra duty. During that time it will be both cleaned and inspected. The fireman may be held responsible for the cleanly appearance of his engine above the running-board. Below that, the work will be delegated to the roundhouse force. The fireman will probably feel that it should clean all the engine. When he feels particularly aggrieved over the matter it is time for him to meet one of the veterans of

the service, who will tell him of the days when the engines were gayly ornamented with brass and light-colored paints, and the fireman's career had added to it an endless campaign with his wiping rag against the tendency of the bright-work to tarnish. There are some things that decidedly favor the fireman of the present time.

There are not always sufficient roundhouse facilities at every point; the traffic of our railroads has a way of constantly running away from the facilities; and so there are many times when the engines must be housed in the open. But the vigilance and the care upon them are never relaxed. The railroad that is foolish enough to try to save upon the maintenance of its motive power sooner or later pays a terrible price for its penurious folly.

So it comes to pass that every engine makes a regular visit to the shops, generally at periods of from ten to fourteen months, depending upon the service in which it is engaged. On some of these visits, it will be pretty completely dismantled, and a travelling crane running the full length of the erecting shop will soon lift the heavy boiler from frame and wheels and carry it down to the boiler-makers, with no more difficulty than an automatic package carrier in a dry-goods store would have. There is a deal of pride and rivalry between the men as to the facility and speed that can be shown in taking an engine in hand, dismantling it completely, making necessary repairs, setting it up again and placing it in service once more. The men of the Erie shops at Hornellsville succeeded in doing the trick a year or so ago in the remarkably short time of twenty-four hours. In that brief time a locomotive came in from the road, bedraggled and begrimed and marked "TBMF" for the benefit of the shop-men. "TBMF" translated means "Tires, Boxes, Machine, Flues," so specifying the engine parts to be repaired. In the slang of the repair shop the men say "To Be Made Fast." These four requisites are the ones most necessary to make the locomotive fit for from 50,000 to 75,000 miles of serv-

ce before she shall again turn into the shop. To make hem in twenty-four hours required some planning on the part of the Erie shop foremen at Hornellsville, and yet t was only a few weeks after 1734 had come out of the Hornellsville plant fit for revenue service in a single day and night, before the men of the rival Susquehanna shop wished a chance at a contest of that sort. "TBMF" generally keeps a locomotive in the shop for from a fortnight to three or four weeks; the Canadian Pacific considered that it had done a remarkable thing in effecting these repairs on a locomotive, with a super-heater, at its Winnipeg shops in 57½ hours. The Hornellsville record was one most remarkable. But the Susquehanna shop men took 2018 in off the road after 70,000 miles without repairs; took in the big puller at 7 o'clock in the morning, made the heavy "TBMF" repairs, and turned her out for revenue service at 7:34 o'clock in the evening — thirteen hours and thirty-four minutes. At midnight she was pulling a heavy through freight west once again, and a most astounding record in American shop work had been consummated.

The United States have few such towns as England possesses in Swindon and in Crewe, railroad towns in the distinctive sense that they were the absolute creation of the railroad in the first instance. There is many a town from one ocean to the other that has owed its stimulus and development to the location of large railroad shops and terminals within its boundaries, but the railroads have, as a rule, dodged the creation of distinctive towns. Pullman, within the outskirts of Chicago, was a monumental failure in this very sort of enterprise. It was designed and built to accommodate the great car-building shops of that man who did the most of all men to make luxury in railroad traffic — George M. Pullman; and no greater care was shown in the construction and design of the works than was given toward the stores, the churches, the schools, and

the homes of the workmen. Pullman was decidedly a model town; yet Pullman was a failure. Other model towns of the same sort in Europe have been marked successes, and that very thing may well serve to illustrate the difference in temperament between the American and the European workingman. The American resents too much being done for him; he is instinctively jealous of his individuality.

Away back in the long-ago the Erie created a railroad town at Susquehanna in the extreme north part of Pennsylvania. It built shops there and soon after repeated the experiment at Hornellsville in the southwestern part of New York State. The Baltimore & Ohio Railroad similarly developed Cumberland, Maryland; and the Lake Shore, Elkhart, Ind. These are few of many instances where a great railroad shop has served to develop a sizable town. In some others they have developed important suburbs of large cities, as the Lake Shore's plant at Collinwood, at the eastern edge of the city of Cleveland; and the great shops of the New York Central at Depew, in the outskirts of Buffalo, which were built when the plant at West Albany could no longer accommodate the rolling-stock of a rapidly growing system.

In Altoona, Pa., the United States possesses probably the only distinctive railroad town of extent within its boundaries. Altoona was the creation of the Pennsylvania Railroad more than half a century ago, and its progress, carefully stimulated, has proceeded step by step in company with the progress of one of the largest of American railroad systems. The mistakes of Pullman have not been repeated at Altoona. If the Pennsylvania Railroad has ruled the city in the hills, it has ruled it tacitly and tactfully at all times. It has avoided even the appearance of paternalism, and the growth of Altoona has been measured by the growth of the country, which in its turn is measured with marvellous accuracy by the growth of the railroad traffic. So a trip to Altoona and through

its great shops will be illustrative of the very best practice in the construction and maintenance of a railroad's car and engine.

The Altoona shops are unusual in the fact that both locomotives and cars of the highest capacity and finest type are built within them, in addition to a great repair and refurnishing work being carried forward there at all times. To do this work, the plant, employing during the seasons of heaviest traffic something like 15,000 men — is divided into several divisions that stretch themselves along the railroad tracks for about six miles.

The first of these divisions consists of the foundries, devoted largely to the manufacture of cast-iron car-wheels of every size and grade. Extensive cupolas, core-rooms and moulding-floors are provided for making 1,000 car-wheels every 24 hours. There is the blacksmith shop as part of this particular plant. The blacksmith is one of the handiest of men about a railroad shop and one of the few to survive the almost universal introduction of machine processes. There are also the machine and pattern shops, together with a large foundry for the manufacture of castings for cars and locomotives, having a capacity of 200 tons a day.

The second division of industrial activity at Altoona is the locomotive repair shop. This is the largest of all the individual plants at that point, employing about 5,000 men, and with its three- and four-story structures built closely within a busy yard it is a veritable city within a city. It has a capacity of about 1,800 reconstructed and repaired locomotives a year and is a shop well calculated to fill any one with respect.

The third division is the Junction shops, where the new locomotives are built; 1,800 men are employed within it, and there men take the new castings and forgings (most of the castings coming up from the giant foundries that we have just noticed), and from them they create that almost human thing, the railroad locomotive. When the

locomotive emerges from that shop it takes its turn upon the testing-table, the mechanical experts place their final stamp of approval upon it, and at last it goes out from the shop, under its own steam, to perform the great work for which it was created.

The testing-table is one of the most interesting of Altoona's activities. The engine is run upon a series of wheels that fit exactly underneath its own; it is fastened snugly into place; connections are made with a score of pipes and rods that fit upon its mechanism, and it starts off for a run up over the division. It runs miles and miles, snorting furiously over the hard grades and under the heavy loads it has to haul, and yet it does not move even the finest fraction of an inch from that testing table. Its mechanism throbs with energy, its wheels revolve at a fearful rate; yet it is a helpless caged creature in a seemingly impotent energy, as the men in charge of the test watch a dozen dials, notebooks in hand. The big driving wheels turn only upon the friction wheels beneath them but the engineers who are conducting the test can tell the speed at which the locomotive is travelling — in theory — by the almost human needles upon the dial-faces. There is more delicate scientific apparatus behind the engine. It is stripped from its tender for this test, and by this apparatus the pull of the engine upon the dead load of the train can be exactly estimated in pounds and ounces. Nor is this all. The friction wheels underneath the drivers are controlled by powerful water brakes, and by the regulation of these brakes, strains or handicaps can be placed upon the engine exactly similar to those of the grades it may have to reach over a heavy mountainous stretch of railroad.

There is no guess-work about modern railroading. Many hundreds of thousands of dollars are spent each year in expert scientific tests of every sort, in the salaries of men who devote their entire time to this work; and the railroads reap the benefits in many more hundreds of

thousands of dollars in operating economies. Railroading is a pretty exact science; the big engine on the testing-table at Altoona is only one of a host of evidences of the skill and genius that are being brought to bear upon the operation of the great railroad properties of the country at the present time.

This engine goes upon diet. Dr. Wiley down at Washington with his young men sustaining themselves scientifically upon measured and selected foods has something of the same method that is shown with the test engine up at Altoona in the hills. Its supply of coal is carefully weighed and analyzed by sample. An accounting of the amount consumed down to ounces is carefully kept, the water supply is also examined and measured with great care. When the test is finished and the big chaotive engine has covered miles of theoretical grades with a long theoretical train hitched on behind, the experts get busy with their pencils and begin to prepare the reports upon which their chief may rely when he goes ahead to construct another gross of 100-ton locomotives.

The car shops rank next in importance to the locomotive shops. The foreman of this plant tells you casually that it has an annual capacity of 300 new passenger cars and 3,600 new freight cars. It is a great plant of itself, some seventy acres of ground covered with great construction buildings. Some of these are in roundhouse form, for convenience in handling equipment under construction; others are set side by side and easily reached by use of a long transfer table.

The work of erecting the freight equipment is carried on quite separate from that of the passenger car work. The almost universal use of steel in the manufacture of every sort of freight car, save the box-cars, which still have wooden walls and roof built upon a steel foundation, has made a large steel-working shop a necessary adjunct of every car-building plant. One of the most interesting fea-

tures of the Altoona car-building plant is a giant hydraulic press situate in the open, just outside of the steel-working plant. This press brings a dead weight of 1,500 tons down upon the sheet of steel that it receives. It is used in making the sills of the freight-cars — "fish-bellies," the master car-builders call them — and under that giant press a sheet of steel, one-half inch in thickness and from thirty to forty feet in length, is bent into shape as easily as you might bend a sheet of soft cardboard within your fingers. The press makes many hundred "fish-belly" sills every working day, and it pays its way.

The steel-working in this shop has been carried forth into passenger car construction and a great shed given over for that work. Within it one sees the gaunt frames of the cars that are to be, gaining shape, until at the far end of the shop is a line of the cars, completed as far as the steel workers can carry them, and ready to be swung by one of the ever-busy switch-engines to the finishing shop, and then finally to the paint shop.

Even with the steel car coming into its own, there are still hundreds of thousands of wooden cars in operation; and the construction of wooden cars will not cease for many years. While steel as a raw material is not far in advance of the cost of wood these days, the cost of fashioning it into cars is still so excessive as to make it impracticable save in cases of extremely profitable operation. One of the strongest points in favor of steel in car-construction is that of the economy of its maintenance, always a strong point with railroad men. The wooden car feels the wear and tear of life upon the rail keenly; in the case of a wreck it is not to be even compared with the steel car.

It should not be forgotten, though, that the railroads have many thousands of wooden passenger-coaches still in service, and the substitution of steel equipment for these has only just begun. The average life of a car approximates twenty years, and the simplest of railroad economics demands that these cars be retained for their active life.

As they wear out steel cars can be, and they already are being, substituted by the great systems. This new equipment is being used at first upon the main lines and through trains, where both speed and density of traffic demand the railroad's best equipment. Gradually it will be spread to the trains and branch lines of less importance.

With the wooden car still a factor in railroad equipment, the carpenter has not yet lost his vocation in the shops. There is much of the coarser work on the freight cars for him; in the elaborate passenger coaches, dining-cars and other equipment of that class, the great mass of cabinet work still demands the cunning of his hands. Here in the miscellaneous carpenter-shop he is at work upon a seat frame for a day-coach, a shade fixture, a broken chair from a dining car, a baggage truck from some station; there is plenty of work for the carpenter around a car-shop.

It is a matter of pride with the railroad to keep its passenger equipment bright and shiny and new of appearance. It is part sentiment and part good business. For a railroad cannot hope to attract passengers with dirty, unkempt, weather-beaten cars. So it is that the paint-shop is a large function of the car-shop. American railroads may not go quite as much into gaudy car decoration as do the railroads of England and continental Europe. Each year the canons of simple good taste are driving the car-designers to plainer models, but no expense is spared to make car-surfaces, within and without, as bright and shiny as those of a private carriage or an automobile.

So it is that a passenger coach spends from eighteen to twenty days in the paint-shop alone, in its period of refurbishing. It is primed at first and then it receives from three to five coats of surfacer. This is all hand-work, requiring both strong muscles and infinite patience on the part of the painters. Two or three coats of the standard color of the railroad, by which its equipment is known distinctively, are given to the exterior. Lettering and

striping follow, then finally two coats of fine varnish are flowed and rubbed to a high and brilliant polish.

The car is now ready for the dust and the dirt of the line. About every year it will come back again for re-varnishing and at the end of about eight years it will again undergo practically the same treatment within the paint-shop as was given it at the beginning. It will come in rusty and begrimed after many thousands of miles up and down the toilsome line. Within three weeks it will emerge from the paint-shop fresh and radiant, having obtained a new lease of life.

If the same process were to be applied to the freight equipment, the paint-shop would be of almost unlimited size. But freight-cars are not varnished. They are merely painted with the best of time-resisting pigments, usually a dull and sombre red. The freight-cars literally go through a bath in the paint-shop. Expert painters stand, like fire-fighters, with a hose-nozzle in their hands. Through the hose the paint is forced, gallons upon gallons of it; and when it is all over the freight-car is a fine, even red, just like the painters themselves. The lettering is a quick matter, with the use of stencils.

There remain two other great divisions of a central plant of this sort — locomotive repair shops and car repair shops, for the needs of the immediate divisions with their heavy traffic. These shops, extensive in themselves, present no radical differences from the usual division shops which a great railroad maintains at every division operating point in order to keep its rolling stock in the best of order. They are used to make light repairs. The master mechanic is a discerning man. He must know and judge accurately when a disabled car or locomotive should go to the company's main shops, when the repairs can best be made at the local plant. It is one of the points upon which the economy of the shop system depends.

On this matter of shop economy whole volumes might be

written, and have been written. In the beginning of shop practices there was little system in these matters, just as the shop work was reckoned far below its real importance. One of the earliest of real railroads was the Columbia & Philadelphia — nowadays one of the main stems of the Pennsylvania's trunk line — and it was from the beginning a railroad of quite heavy traffic, double-tracked and reaching into a fat country. Yet a shop at Parkersburg, halfway up the line, employing forty men in all, was considered quite enough for the maintenance of equipment. If one of those early engines broke down at either terminal, the engineer, the fireman and perhaps the local blacksmith had to make their own repairs.

Nothing was standard, not even the sizes of such simple affairs as nuts and bolts. Years of railroading have changed all this. The master-mechanics and the master car-builders meet in annual sessions; and by means of reports from their expert committees have been evolved standards in every detail of rolling stock — standard materials, standard compositions, standard sizes, even standards in nomenclature of railroad apparatus down to the smallest parts.

Even with this assistance there still remains a mass of detail in every railroad shop; and a large clerical force is one of its greatest efficiencies. A sharp and accurate accounting is kept of the cost of repairs upon each locomotive and car, even such general shop costs as gas and heat are pro-rated against it. There is no time that the railroad cannot tell to a nicety the precise cost of each unit of its equipment.

These units are not, in many roads, increased, without precise orders from the board of directors or the executive committee of the board. In order to get around this rule some niceties in reconstruction have been known. A single timber of a worn-out freight car has kept the unit and the number of the old car, and going into the new has prevented the creation of a forbidden unit.

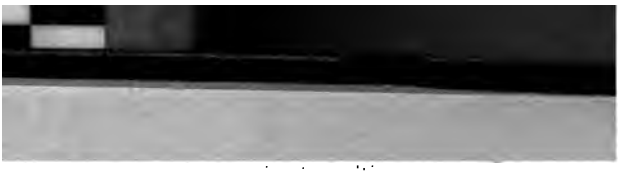
The system upon which cars and locomotives are numbered varies greatly upon different systems. In some cases the first figures of the numbers indicate the class and style of the car or locomotive, in others they mean nothing. When a car or a locomotive is nigh worn out its number passes from it and is given to some newcomer. The old servant has a neatly painted "X" placed before its number. That "X" is its death warrant. In a little time it leads the way to the scrap heap.

The men who labor in the railroad shops see little of the romance of the line. Their work is much like that of the men who work in every sort of large shop. Their responsibility is not less than that of the other railroaders, the men to whom 150 or 300 miles of line and out-spread towns are as familiar as the very rooms of their own homes. A flaw in the steel, a careless bit of shopwork, may serve to derail the express at the least foreseen moment, to cause disaster in the ringing way that every railroad man sees at one time or another. It may not always be possible to trace the responsibility for such an accident. But there is a responsibility, and the men who work at forge or lathe, at press or planer feel that it is there. They form no mean brigade of this great industrial army of America.

Such responsibility continues outside of the main shops to the smaller shops, down to the roundhouse forces, by whose care and vigilance the big locomotives are kept fitted for their important work; down still farther to the car-inspectors, who, blue signal-lights in hand, creep through the long freight-yards of a winter's night to strike the flaw in the metal, to sound the note of alarm before the worst may come to pass. Some of these last you hear in the night as you scurry across the country. As you rest in your berth, and the express is changing engines at some division point, you may hear the car inspectors coming along the train, striking with their hammers against the

wheels, listening intently for the false ring by which they may detect trouble. If you trouble yourself to lift the curtain of your berth, you may see them, a grimy crew, working busily with their hammers, thrusting their torches in among the trucks to see that all is well.

Responsibility for the safety in railroad operation does not cease at the doors of the mechanical department.



CHAPTER XXV

THE RAILROAD MARINE

STEAMSHIP LINES UNDER RAILROAD CONTROL — FLEET OF NEW YORK CENTRAL — TUGS — RAILROAD CONNECTIONS AT NEW YORK HARBOR — HANDLING OF FREIGHT — FERRY-BOATS — TUNNEL UNDER DETROIT RIVER — CAR-FERRIES AND LAKE ROUTES — GREAT LAKES STEAMSHIP LINES UNDER RAILROAD OWNERSHIP.

IN the beginning land transportation must have looked up in something resembling fear and awe to water. We can picture the railroad of the thirties as a slender but resourceful David facing the veritable Goliath of water carriage. In earlier chapters of this book we have shown how the canals, representing a distinct phase of water transportation, sought to throttle the railroads at the beginning. But the modern railroad has no fear of water rivalries, either upon the coast or inland. Just as the first railroads were ofttimes timidly built as feeders or complements to water routes, so to-day almost every inland water route is part of a railroad — in operating fact if not in actual ownership. The tables have been turned — the railroad finally dominates. Nine-tenths of all the great water routes in and aroundabout the United States are more or less directly owned and controlled by the railroads. They have become, in every sense, corollaries to land transportation.

This is more distinctly shown in some sections of the land than in others. For instance, up in New England, where the interests owning the New York, New Haven & Hartford Railroad have accomplished direct or indirect control of all but a comparatively few miles of the steam and electric railroads in five great States, they have also acquired the steamship interests of that district. The

New Haven's original excursion into the steamboat business was when it absorbed the Old Colony Railroad — almost a score of years ago — in order to ensure its entrance into Boston. The Old Colony owned a well-famed and highly prosperous steamboat line from Fall River, Massachusetts, to New York City, part of its through New York-Boston route. Eventually the New Haven acquired all the brisk and busy steamboat lines which ran up the Sound from New York to several Connecticut ports — Bridgeport, New Haven, Hartford, New London, and Stonington. Any one of these lines was not, perhaps, so much of an acquisition in itself, but all of them were potentials in a future rate situation that might arise. It was good executive management to have these potentials under firm control, and so the New Haven established water routes as a recognized factor of its business — under the separate corporation title of the New England Navigation Company. Once when a new company, under the mellifluous title of the Joy Line, sought to injure its coastwise business by establishing cut-rates from Providence to New York, the New Haven placed two of its older boats in a rival and lower-priced service, and, by means of its great resources, was able to bring the Joy Line into its fold. Later, when the Enterprise Line tried a like programme, the New Haven followed the same aggressive tactics and brought the Enterprise Line to bankruptcy. These things are mentioned here in no spirit of criticism. But they are the facts that make it impossible for really independent lines of steamboats to run between New York and Providence for any great length of time, despite ample docking facilities and a great free port at each of these cities.

The Metropolitan Line tried to maintain an independent line between New York and Boston with the two finest steamers ever placed in coastwise service — the *Yale* and the *Harvard*. One of these boats left each city at five o'clock in the afternoon and performed the ocean voyage

of 330 miles over the "outside route" in just fifteen hours — and with amazing regularity. But the New Haven Railroad found it to its interest to control the coasting lines around about New England, and so the *Yale* and *Harvard* were last winter banished to the Pacific coast.

This is all part of the business of managing great railroad systems. For similar reasons the Pennsylvania Railroad found it advisable to bring a group of steamboat lines plying on Chesapeake Bay and its tributaries under its control, the Harriman lines to reach out and establish ownership of the lines plying up and down several thousand miles along the Pacific coast — these are but a few instances out of many. As yet no large American railroad has essayed to control a transatlantic line, although both the Hill and the Harriman properties are interested in the transpacific carrying business. The Canadian Pacific, however, has already well-established lines across both of the great oceans — making a continuous route under one management from Liverpool, England, to Hong Kong, China. Moreover, it is now building four great steamships which are to be finished simultaneously with the Panama Canal and which will ply through it from New York direct to Hong Kong. The Canadian Northern has also recently embarked in the transatlantic carrying business. The Canadian Pacific and several of the large railroads of the northern part of the United States maintain lines of sizable gross tonnage on the Great Lakes — but of these, more in a little while.

Even if a railroad is not engaged in the steamship business, as such, even to the extent of one or two small steamboats on inland waters, it may still possess a considerable harbor fleet,— wharves, and slips — that, taken together, make a sizable aggregate. Every railroad that has any sort of ambition to be considered a trunk-line will count upon having one or two or even more terminals upon navigable streams, and at these it will protect itself by having

A MODERN RAILROAD FREIGHT AND PASSENGER TERMINAL: THE TERMINAL OF THE WEST SHORE RAILROAD AT WEEHAWKEN, OPPOSITE NEW YORK CITY

HIGH-SPEED, DIRECT-CURRENT PASSENGER LOCOMOTIVE BUILT BY THE GENERAL ELECTRIC COMPANY FOR TERMINAL SERVICE OF THE NEW YORK CENTRAL AT THE GRAND CENTRAL STATION

of his ship. But Detroit and Cleveland and Buffalo and Chicago do not have the tides — and it is the tide that makes harbor navigation a finely specialized science at the big ocean ports.

All of the big Atlantic ports save New York have abundant track facilities alongside the piers, where berth the ships from half the world over. In New York, the same geographical conditions that have gone to make her so superb a port and given her so generous a harbor-frontage have blocked the railroads in their efforts to reach all her piers with unbroken rails. So the railroads entering that harbor have found it necessary to provide themselves with such fleets as we have noticed as belonging to the New York Central. For inland shippers seem to have a preference for sending their east-bound export merchandise through New York, because of the frequency of sailings from her wharves to half the recognized ports of the world.

If you are a manufacturer — at Utica, N. Y., let us say — and you wished to send a carload of your product to London, Eng., you would find that the railroad definitely agrees to do certain things for you. On your minimum basis of a carload lot it will place that carload at any pier in the harbor of New York. Indeed, it would do a little more. If some of that carload lot that starts down out of Utica is going to London, some more on a different ship to Calcutta, and still some more on a tropic-bound liner to South America, the railroad would make free delivery of your consignment to the piers of these three ships. It limits, however, the delivery of a carload lot to three different piers.

This sounds simple, perhaps, and, in reality, is not. For in a single day of twenty-four hours there may arrive at Weehawken and Sixtieth Street, Manhattan — the two great freight terminals of the rails of the New York Central system at New York — from four to six hundred, eight hundred cars, perhaps, filled with merchandise bound

for half a hundred different piers, along from forty to sixty miles of water-front.

Now you see the use of all this army of lighters and barges — stubby-nosed craft, awkward craft, boats that have not even a single stanza of the poetry of the sea written upon their contents. By night, by day, when an imperial city throbs with the bustle of brisk endeavor, and still when it tries to snatch a few brief feeble hours of rest, in summer, in winter, when the two rivers and the great upper bay of New York harbor are alive with gay pleasure craft, and in the trying hours when a pilot's path is fraught with the dangers of drifting ice and laid through gray blankets of mist, this great interchange of freight of every sort goes forth. The eight or ten great railroads that terminate in New York are pouring export merchandise to all of her piers, while from those long sprawling structures they are drawing up imported goods to go forward to every corner of the land. And in addition to this there is the vast local commerce of the City of New York, which, as we saw when we were considering the freight terminals, back in Chapter VII, is no slight matter of itself. But this traffic, as well as much of that of the great interchange between the railroads terminating at New York, is handled most effectively by the car-floats on each of which twelve to sixteen standard box-cars may be loaded with great expedition.

But the clumsy barges and the lighters and the still clumsier car-floats are of little use without the tugs, and these last are the quick couriers of the harbor. Twenty of that New York Central fleet are kept in constant use on the North and East Rivers, and along the harbor shores to Jersey City, Bayonne, and the southern parts of Brooklyn. They do not lie idle, save when they are finally forced to "lay up" for a little time for repairs. And then a reserve tug is in service without delay.

Here is the modern economy of railroad equipment — even though this be the part of the railroad that is afloat.

A tug pulls up to a dock, its crews are off almost before their "relief" is standing at its station, and making sure that the craft is in as good order as they left it. While the "relief" is finding its tired way toward home the tug is off again. Its work is constant. Its work is not easy. It does not seem to be systematic and yet it is — wonderfully systematic.

For here and there about the harbor the captains of these N. Y. C. tugs get their orders — just as conductors of the trains upon the steel highways get their clearance cards and yellow tissues. A half-dozen stations give orders, and these are but the speaking stations of a single man who sits before a telephone switchboard close by a narrow street of down-town Manhattan and directs tug movements through the crowded harbor, just as easily as a despatcher moves extra freights over a crowded stretch of single-track line.

The traffic runs flood-high and the station men gossip of the whispered complaints of the tug-crews, but the man at the switchboard only smiles. A traffic solicitor who plies his heartbreaking work on the floor of the near-by Produce Exchange comes over to him and says:

"I 've promised Smith & Russell delivery of ten cars of flour at Pier 32, East River, at seven o'clock to-morrow morning. We can't go back on them."

The man at the switchboard does not lose that smooth-set smile, even though the loudly ticking clock, just above the plugs and cords, shows him that it is already six o'clock of the evening of a day when the harbor freight has run flood-high.

"All right," he laughs, "Smith & Russell can count upon us."

And the next moment he is ordering Tug Twenty-seven to go from the Sixtieth Street pier over to Weehawken to get that small mountain-range of flour-bags that the "huskies" have already begun to build on a pier-floor,

le of a string of dusty, grimy cars that have
l their way east from Minneapolis.
aps you are interested in the personality of Tug
-seven. Take yourself away from the cool-witted
her and look down upon this craft — the queen of
ad pet marine. She is as resplendent in her green
ld as any gentleman's yacht, and her crew even
roud of her. She stands in the water, a mere 110
g and 24½ feet beam, but those wonderful shining
in her heart can develop 1,200 horse-power —
ı as many steamboats of three times her size. Her
be boilers can withstand a locomotive pressure of
unds to the square inch, she has all the accoutre-
)f coast liners — steam steering gears and electric
mong them. No wonder that her captain waxes
t about her.
ask him about what she can do. That he takes
)nal achievement, and these harbor men are a bash-
Still, you can worm it out of him, and after a
ou find that Tug Twenty-seven has just brought a
sed car-float, with sixteen loaded cars upon her
round from Corlears Hook, through the press of
g, and around the Battery where cross-tides battle
one another and against craft of all sorts, up to
wken "bridge" in forty minutes — which is not
bad for a ten-mile run through a congested harbor.
me counts," adds the captain. "If they had given
ther twelve or fifteen minutes I could have brought
two of the floats — put together 'V' fashion and
enty-seven with her nose stuck up into the 'V'."

ıe harbor of New York is a great cluster of ferry-
perated to overcome her barrier rivers by the sev-
ınk-line railroads whose systems terminate at a long
ump from the congested Island of Manhattan. To
e with railroads boasting terminals on Manhattan

Island itself, these lines have been compelled to equip and operate extensive ferry fleets across both the East and the North Rivers. Across the first of these streams operates the navy of the Long Island Railroad, while across the Hudson ply in an intricate interlacing more than a dozen ferry routes of the Central Railroad of New Jersey, the Pennsylvania, Erie, Lackawanna, and the West Shore Railroads. The recent completion of the New York-Jersey City-Newark routes of the Hudson tunnels, as well as the inauguration of passenger traffic through both North and East River tunnels to the new Pennsylvania terminal in Manhattan, has caused the abandonment of two ferry routes and curtailment of service upon several others. Tunnel-diggers and bridge-builders make havoc with ferry routes, which must always remain liable to many delays because of fog, floating ice, and such other adverse weather conditions.

Still the railroad ferries round about New York derive no small income from the trucking service of a metropolitan city which has had to struggle for many years against great intersecting rivers, and so they will probably continue to be for many years interesting and picturesque features of New York harbor.

But perhaps the most interesting of all the ferry routes of New York harbor is the attenuated line from the New York, New Haven & Hartford Railroad's waterside terminal at Port Morris in the Bronx, for ten miles through the East River, Hell Gate, around the sharp turn and tides of Corlears Hook and again of the Battery, and across the Hudson River to the old terminal of the Pennsylvania Railroad in Jersey City. Over this route goes through traffic — freight and passenger — from New England to the South and the Southwest. The freight-traffic is handled largely by car-floats in charge of the busy puffing tugs, while the passenger traffic goes in ferry-boats different from the others that ply in New York

For these ferry-boats are really nothing more than a ttered type of car-float — a type equipped with power- l engines for self-propulsion. Through passenger ains run each day and each night between Boston and altimore and Washington, and these trains are handled etween Port Morris and Jersey City upon them. The miliar *Maryland,* which is operated jointly by the New laven and the Pennsylvania systems upon this route, will ceive an entire passenger train of ordinary length, ex- pting, of course, the locomotive, upon her great deck, hich is, in reality, a miniature railroad yard, equipped ith two long parallel tracks that can be quickly attached the ferry-bridges at Port Morris and Jersey City. The ip, with the loading and unloading of the train, is ac- mplished, under favorable weather conditions, in about hour.

It makes a pleasant break in the day trip from the cap- l of New England to the capital of the United States, spend an hour tramping up and down a broad ship's ck, or dining in a roomy, sun-filled cabin, while New rk itself is as completely ignored as any small way- tion along the run. New Yorkers themselves have long ce become too accustomed to seeing the long train rried upon the water-way that separates the two great- boroughs of the city, to give it more than passing ought. This ferry is also finally threatened by the idge-builders. As this is written, workmen are already eparing the pier foundations for a great railroad bridge at is to span the East River not far from Hell Gate, and hich is to give an unbroken line of rails from the New aven's terminal at Port Morris, through Long Island ty, to the Pennsylvania's tunnels and terminal in Man- ttan Island.

So, also, have the tunnel-builders contrived to rob the rough traveller on the Michigan Central of the more less thrilling water transfer from Canada to the United ates at Detroit. The Detroit River tunnel has super-

seded one of the most important car-ferries in the country, but it has given to the operating heads of the Michigan Central one of the very shortest through routes from New York to Chicago and robbed them of one of the fearful handicaps of their main line — the possibilities for constant and exasperating delays to their through trains while being ferried across the Detroit River.

Do not underestimate the possibilities of those delays. Within the past ten years, the transport *Michigan*, plying from Detroit to Windsor, the Canadian town directly opposite, and carrying a Chicago-Montreal flyer, was stuck for ten hours in the ice, so near the slip that a long plank would have almost reached from her deck to the wharf. That, in the lesser form, has been the history of winter after winter at the Detroit ferry. Shipbuilders have done their best to meet the obstacle by building car-ferries of tremendous power, sometimes even equipping them with both side-wheels and screws. But the real problem of possible delay can only be solved there by tunnels, and it is expected that the Grand Trunk, the Canadian Pacific, and the Wabash — which still use the car-ferries across the Detroit River — will sooner or later either tunnel beneath it or acquire trackage rights through the Michigan Central tubes.

The Detroit River is a narrow but important part of the tremendously important water highway up the Great Lakes, and at every part of the whole length of that highway the railroads have tried to break their way across. It has not been found impossible to bridge the St. Lawrence or the Niagara Rivers or the wide straits at Sault Ste. Marie, but there are other points, even besides Detroit, that have as yet baffled the genius of the bridge-builder. One of the most important of these is where Lake Michigan forces its outlet into Lake Huron through the two peninsulas of the great State that bears its name. To make the two parts of Michigan physically one with unbroken rail will probably not be accomplished in many

years. In the meantime the stout and tremendously powerful ferry *Algomah* — built so as to literally crush the ice down under her tremendous bows — plies between Mackinac City, the Island of Mackinac, situated midstream, and St. Ignace, on the north shore of the broad strait. Despite the fearful severity of the winters in northern Michigan the *Algomah* keeps that important path open the year round — not only for herself but for the great car-floats that follow in her wake.

What is possible at the Straits of Mackinac is also possible across the widest part of any one of the Great Lakes — excepting always the emotionless Superior. At least that is the way the railroad traffic men have argued for many years, and so for these many years car-ferries have plied successfully across the very hearts of three of the lakes. Of all the chain, Lake Michigan offers the greatest natural obstruction to the natural traffic movements of the land — its great length, stretching north and south, forming an obstacle to through rail movements, and contributing not a little to the railroad importance and the wealth of Chicago.

So it was that car-ferries were established many years ago across Lake Michigan and are operated throughout the lake to-day — from Manitowoc, Kewaunee, Milwaukee, Menominee, and Manistique on the west shore of the lake, to Frankfort, Ludington, Northport, Grand Haven, St. Joseph, and Benton Harbor upon the east shore. These vessels are of different construction from the ferries that cross the narrow Detroit River. They lack the low freeboard and the other typical ferry construction, and are, instead, deep-gulled vessels, generally built of steel and always of great structural strength.

"Like the river ferries," says James C. Mills, "they are ice-crushers, but of greater size and power. During two or three of the winter months the lakes are frozen in a solid sheet of ice for twenty and thirty miles from the shores, and in extremely severe winters the ice-fields meet

in mid-lake. To keep a channel open in the depth of winter even for daily passages back and forth, is a hazardous undertaking for the hardy mariners. The frequent gales which sweep the lakes break up the fields into ice-floes which, driven one way or another with great force, pile up in huge banks, often in the direct course of the transports and as high as their upper decks. At such times they free themselves only after repeated buckings of the shifting mass of ice, sometimes miles in extent, by running their stout prows up on the edge of the mass, breaking it down by their sheer weight, and ploughing through the ragged, grinding blocks of ice thus formed." *

Four tracks, running the full length of the ship, generally fill the main deck of these trans-lake ships. The loading of the cars on to these tracks is accomplished at the stern, the bow being built high and, as we have just seen, somewhat after the fashion of an overhanging prow. The main deck is completely roofed over with cabins and deck-houses, so that, viewed from the rear, the ship seems to be an itinerant pair of railroad tunnels, dark and gloomy. The upper decks are gay with the resources of the marine architect — for the greater part of these boats offer accommodations for passengers as well as for from eighteen to thirty freight cars. These great ferries form valuable feeders to the Grand Trunk, the Pere Marquette, the Ann Arbor, and Grand Rapids & Indiana, and some minor routes crossing Michigan.

Similarly, car-ferries crossing Lake Erie from Cleveland to Port Stanley are considerable factors both in general merchandise and in the coal trade. Another Lake Erie route of heavy tonnage extends from Ashtabula, Ohio, to Port Burwell, Ontario. Within the last few years a car-ferry has been established across Lake Ontario, from Charlotte — which is the port of Rochester, N. Y.— to Coburg on the Canadian side, which has already developed for itself a considerable traffic.

* "Our Inland Seas," by James C. Mills, 1910.

But the car-ferries, extensive as they are, form but a small portion of the railroad interests upon the waters of the Great Lakes. Almost all of the great lines through those much-travelled waters are the property of some railroad system whose rails touch one or more of their terminals. Thus the Northern Steamship Company, running from Buffalo to Chicago and Duluth, touches the rails of its parent company, the Great Northern Railroad, at this last port. The Erie & Western Transportation Company — popularly known as the Anchor Line — also running from Buffalo to Duluth, is a Pennsylvania property. Both of these lines are operated for passenger service, as well as freight. The New York Central and the Erie cover the same territory with exclusively freight routes. The Rutland Railroad has a line all the way from its western terminal at Ogdensburg, on the St. Lawrence River, to Chicago. The Canadian Pacific and the Grand Trunk operate important lines through Georgian Bay and Lake Superior. Even a small road, like the Algomah Central, has its own freight and passenger steamboats running south from the Soo as far as Cleveland, Ohio. It is a pretty poor line with Great Lakes terminals that cannot boast some sort of steamship service of its own.

In the development of the coastwise and the inland waterways of the United States, the railroad may be doing the nation a far greater service than it imagines. For the general trend of railroad expansion in the country to-day seems to be toward a development of the auxiliary water-routes rather than toward their curtailment. The railroad has finally realized that some coarse commodities can be carried far more economically by water than by rail. It is to-day seeking to avail itself of that acquired knowledge. If competing and feeding trolley lines are good things for railroads to own — and the present-day judgment seems to be that they are — the same rule holds doubly good in regard to both competing and feeding water-routes.

CHAPTER XXVI

KEEPING IN TOUCH WITH THE MEN

THE FIRST ORGANIZED BRANCH OF THE RAILROAD Y. M. C. A.—CORNELIUS VANDERBILT'S GIFT OF A CLUB-HOUSE—GROWTH OF THE RAILROAD Y. M. C. A.—PLANS BY THE RAILWAYS TO CARE FOR THE SICK AND THE CRIPPLED—THE PENSION SYSTEM—ENTERTAINMENTS—MODEL RESTAURANTS—FREE LEGAL ADVICE—EMPLOYEES' MAGAZINES—THE ORDER OF THE RED SPOT.

THE historic gray Union Station, which still stands at Cleveland, housed what was destined to be the very first systematic effort of the railroad to get in touch and keep in touch with its men. In that building, once new and splendid, but now old and grimy, George Meyers, the depot master, gathered a group of railroaders on a Sunday away back in 1870. The man came again on a second Sunday, still again on a third; after a little while those Sunday afternoon gatherings became habitual, and a new kink in all the intricacy of railroading was established. The meetings were partly religious and partly social, and eventually they led to a distinct innovation in that depot.

This little conference of Meyers was, in 1872, developed into the first organized branch of the railroad Young Men's Christian Association. General John H. Devereux, the general manager of the Lake Shore & Michigan Southern Railway; Reuben F. Smith, of the Cleveland & Pittsburgh Railroad, and Oscar Townsend of the Big Four Railroad were chosen directors of the branch. Henry W. Stage, a train-despatcher on the Lake Shore, was earnestly and intensely enthusiastic in this work; and because of his zeal and enthusiasm, together with that of George Meyers, this branch was successful from the outset.

The Lake Shore Railroad, whose headquarters were in that same Union Depot at Cleveland then was and still is a pet property of the Vanderbilt family, also owners of the great New York Central system. The heads of that family began watching the Cleveland experiment with unusual interest. The reports that came from them were unusual. That scheme of the depot master's seemed to be making a better grade of railroader in and around Cleveland, and any institution that bettered the type of railroaders interested the Vanderbilts. So the thing that Meyers had founded soon had wealthy patrons and strong friends.

The Vanderbilts kept their shoulders to the wheels of the railroad Y. M. C. A., kept it out of the ruts and from falling. They saw it introduced here and introduced there on their group of railroads; saw it spread to other lines; and finally, Cornelius Vanderbilt himself built a splendid club-house for railroad men at the great terminal of his road in New York City and turned it over to the management of the railroad Y. M. C. A. That house, standing almost in the shade of the Grand Central Station, after a quarter of a century, still ranks as one of the distinctly fine club-homes of a city that is opulent in club-houses. It is still dedicated to simplicity, to democracy, to decency, and to good fellowship.

There is not a railroader coming into the big passenger terminal — from either the New York Central or the New Haven system — who is not welcome to it, day or night. Engineers, firemen, conductors, trainmen all come into its hospitable door after a long hard run to find the clean comfort of good meals, bath, comfortable beds, good fellowship awaiting them. There is the peculiar and the successful field of the railroad Y. M. C. A.; perhaps as much as any, the real reason for its pronounced success.

Few railroaders in train service can leave their homes in the morning, " double their runs," and be home at night. The hard part of the business is that in most cases a man

will have to spend one night, occasionally two nights, out on the run. The difficulties of this are not readily understood without a slight examination. In a large city the railroader finds that it is a shabby sort of a hotel or lodging-house that can come regularly within his scheme of economy. When he strikes the little town, or frequently the big terminal or division freight-yard around which is no town at all, the problem only multiplies. J. M. Burwick, a veteran conductor of the Duluth & Iron Range Railroad, told that problem in his own sincere way last year at a big dinner of railroad men in St. Louis.

"I left home a beautiful morning in '72," said Mr. Burwick. "I went down to Lafayette and to my first boarding-house; and up to that time I don't think any railroad man ever found a boarding-house except it was tied up to a saloon. I was in a place like that. Another place I was running into was where they made a division point in a corn-field. The company built a large building for the benefit of the men, and then they rented it to be run as a hotel. But the man in charge ran it to make money, and the steak he cut with his razor. I know he did, because it was so thin. At other places we had to sleep in a hot yard, in a hot caboose not fit for a man to try and sleep in; and then we had to stay awake on the road that night."

That was Burwick's testimony as to the conditions just before the coming of the railroad Y. M. C. A. An engineer from the New York Central, a man who had slept many nights in that comfortable club-house at the Grand Central, went up into Canada a few years ago and took an engine on a division running out of Kenora. The only place that a railroad man could find board and lodging in that town at that time was a boarding-house with the saloon attachment, and he was welcome there for but a limited time, unless he was a reasonably liberal patron of the saloon. The engineer — his name is McCrea —

THIS IS WHAT NEW YORK CENTRAL MCCREA DID FOR THE MEN OF THE CANADIAN PACIFIC UP AT KENORA

A CLUBHOUSE BUILT BY THE SOUTHERN PACIFIC FOR ITS MEN AT ROSEVILLE, CALIFORNIA

THE B. & O. BOYS ENJOYING THE RAILROAD Y. M. C. A., CHICAGO JUNCTION

"THE BROOKLYN RAPID TRANSIT COMPANY HAS ORGANIZED A BRASS BAND FOR ITS EMPLOYEES"

changed that order of things and established a branch of the railroad Y. M. C. A., which in four years gained 300 members and threatened to close the saloons of the place.

Now you get the reason for the welcome that the railroad-owners gave this work of the Y. M. C. A. It was not the religious idea alone — men differ in their views of that sort of thing — but one of the most stringent of all railroad rules is that prohibiting the use of liquor by the men, or their frequenting bar-rooms. The necessity of that rule appears upon the face of it. But the Canadian railroad could do little toward enforcing it in a place like Kenora, before McCrea, of the New York Central, arrived there. The railroad Y. M. C. A., with its comfortable housing facilities, its vigorous stand for better morals and better men, has made that rule one of the easiest in the book to be strictly observed. That is why the railroad-owners and the railroad heads, whose religious views have sometimes been at variance with those of the Y. M. C. A., have given hearty endorsement to its work along their lines. They like the sort of man it finishes.

So the railroad Y. M. C. A. has grown. It now has some 240 branches reaching from Hawaii, in the West, to some important division points in Eastern Maine. None of these have houses that can be compared, of course, with the comfortable home at the Grand Central Station in New York. In fact, some of them are still housed in crude fashion, in an abandoned shed or depot that some railroad has fitted up as a start in the work, over some store or freight-house perhaps; but each year sees these replaced by neat homes, such as those at Harrisburgh, on the Pennsylvania; at Collinwood, O., on the Lake Shore; at Baltimore, on the B. & O.; at the St. Louis Union Station, and the Williamson, W. Va., on the Norfolk and Western Railway. On a single system — the New York Central — there are 38 asso-

ciations, with 27 buildings built for the purpose and valued at $700,000, and a very active membership of 12,799 railroaders. In the national organization membership there are more than 85,000 men, representing every department of the railroad service. An average of 15,500 meals — and mighty good reasonably priced meals they are, too — is served daily, while more than 50,000 railroaders come to the club-houses each twenty-four hours.

Beyond the necessity for maintaining the moral fibre of the railroader (and it is astonishing how little maintenance such a corps needs) is the decent necessity of taking care of him in case of illness. Railroading, with all the safety devices that have multiplied in its service within the past quarter of a century, is still a hazardous occupation to the men who are out upon the line. The list of cripples, and the death-list of a twelvemonth, are still appalling things — appalling in the aggregate, fearful in any single concrete case, a case where there may be a helpless wife and little children to be brought into the reckoning.

The railroads have begun to shoulder their responsibility in this matter. Legislation has helped in the matter but to-day big carriers are preparing to do even more — to pay premiums and carry some form of casualty insurance on each of their employees, who may be engaged in a hazardous part of the work. That thing is going to do more than any other one thing possibly could do. When a big railroad realizes that its bill for premiums is going to be reduced by the addition of many simple protective devices, those devices are going to be instantly adopted. That is the way of railroads, and of business, although it is not to be charged for a single moment that the American railroads have not done much within the past 25 years toward raising the margin of safety for their employees.

Of course, the railroaders have long since had their insurance, although the regular life companies look upon them with distrust as risks. They have been forced either to pay high premiums in the regular companies or else to organize insurance of their own. Their brotherhoods have carried forth this work with interest and with skill. These brotherhoods, or unions, of the locomotive engineers, the firemen, the conductors, the trainmen, and several other branches of the service, have been mighty agents, too, in the development of the moral fibre of the American railroader. Lack of space prevents a consideration of each in detail. To do them but simple justice, to sing the epic of the mighty Brotherhood of Locomotive Engineers, for instance (which has only recently finished a great building of its own in Cleveland), would require a volume for itself.

But the railroads have not been negligent in this matter. For instance, a man on the Baltimore & Ohio can pay $1.00 a month out of his pay envelope and have $1,000.00 life insurance. He can likewise pay $3.00 a month, and $3,000.00 will be paid his heirs upon his death. The railroad company stands back of this fund and guarantees the insurance. It makes good from its own treasury any deficit or shortage that might be incurred in its operation.

For twenty years the Pennsylvania has conducted a similar work, under the title of the Voluntary Relief Department. Membership in this is, as the name indicates, purely voluntary, the road's employees being admitted, after favorable physical examination, up to the age of 45 years and 6 months. The Pennsylvania Railroad Company in this instance also stands as guarantor of the insurance fund.

A close examination of it in some detail may interest. The following table shows the detail — the five classes into which employees may enter:

Monthly pay.....	1st Class Any rate	2nd Class $35 or more	3rd Class $55 or more	4th Class $75 or more	5th Class $95 or more
Contributions per month:					
Class	$0.75	$1.50	$2.25	$3.00	$3.75
Additional Death Benefit, equal death benefits of class:					
Taken at not over 45 years of age	.30	.60	.90	1.20	1.50
Taken at over 45 years and not over 60 years of age	.45	.90	1.35	1.80	2.25
Taken at over 60 years of age	.60	1.20	1.80	2.40	3.00
Disablement benefits per day, including Sundays and holidays:					
Accident:					
First 52 weeks.....	.50	1.00	1.50	2.00	2.50
After 52 weeks.....	.25	.50	.75	1.00	1.25
Sickness:					
After first three days and not longer than 52 weeks	.40	.80	1.20	1.60	2.00
After 52 weeks.....	.20	.40	.60	.80	1.00
Death Benefits:					
For Class	250.00	500.00	750.00	1000.00	1250.00
Additional that may be taken	250.00	500.00	750.00	1000.00	1250.00

An employee, however, who is under forty-five years of age, who has been five years in the service and a member of the relief fund for one year, may enter any higher class than that determined by his pay, upon passing satisfactory physical examination.

Payments from the fund vary from forty cents per day for sickness and fifty cents for accident in the service, for members in the first class, to $2.00 per day for sickness and $2.50 for accident with a death benefit of from $250.00 to $2,500.00, according to class of membership and death benefit held.

Since the fund has been in operation, the following

payments have been made, to December 31, 1909, inclusive: —

For Accident death benefits	$2,185,343.40
Sickness death benefits	5,914,811.18
Accident disablement benefits	4,076,636.89
Sickness disablement benefits	7,855,069.73
Superannuation allowances	415,367.55
Operating expenses	3,207,131.06
Total	$23,654,359.81

During the same period, the Pennsylvania has contributed to the fund in operating expenses, gratuities, etc., exclusive of interest, the following:

For Operating expenses	$3,207,131.06
Special payment, etc.	424,571.91
For deficiencies	733,913.89
Total	$4,365,616.86

In addition to what the Pennsylvania is doing in the payment of the pensions and contributions for the maintenance of the relief fund, the relief and pension departments have the use of the telegraph and the train service free of charge; and in case of accident in the service to employees, free surgical and hospital attendance is furnished, and, where necessary, artificial limbs or other appliances, without cost to the employee. No figures are available as to the cost of surgical attendance, or the furnishing of artificial limbs, but it is conservatively estimated by the Pennsylvania officers as equalling the amount paid for the operation of the relief department.

The modern railroad does not wait, however, for a man to become injured or to die before assuming any responsibility for his care. There may come a day when the burden of years makes him a little less fit for the strenuous service of railroading. It is Nature's way of telling man that he has labored well and that he is entitled to a rest. In other days, the railroad recognized this in a rather informal way. It took its veteran employees, re-

tired them into a comfortable ease, and had the paymaster send them checks each month for a part of their old wages. Out of that custom the railroad pension system was born, only with this sharp distinction: In the old way the man was taught to believe his monthly check a favor or gratuity on the part of the railroad; under the pension system he comes to know it, not as an act of charity but as his right, a right earned by long hard years of faithful service.

This idea has begun to be recognized as fundamental by railroad managers. Directors and officers now realize that the pension fund and some of these other features that we have just considered, are causes directly contributing to the efficiency of the railroad. The policy is merely one of good management. Again, let us see the way the Pennsylvania handles this matter, not because the Pennsylvania is alone in this thing, but rather because it is one of the largest and most distinctive of American railroads, and almost a pioneer in this work. Before it began paying pensions to retired employees, the Pennsylvania had already long conducted a relief fund and a savings fund, and had contributed to libraries and railroad branches of the Y. M. C. A.

The pensions are paid entirely by the company. In the year 1909, for instance, $594,000 was paid out to the men who had retired between the ages of 65 and 70. From the time the fund was established until the end of 1909, appropriations for it amounted to more than $4,000,000, now paid to some 2,300 men annually.

Employees may retire for age at 70, or for physical incapacitation between 65 and 69. If they have been in the service as long as 30 years, they are granted an allowance based on one per cent of the monthly wages for each year of service. The percentage is based on the wages received for the ten years preceding retirement.

Thus, if an engineer, or a brakeman, or a fireman, has served the Pennsylvania 30 years, he may retire between

65 and 70 and receive not less than 30 per cent of his monthly wages during the last 10 years of work.

The other railroads using the pension scheme have followed these general outlines for their work. It has become an established feature of railroad operation, and recently a second vice-president was created on the Baltimore & Ohio for the express purpose of handling the company's relief work. Sometimes the railroad organizes savings-funds for employees, paying from three and one-half to as high as five per cent on their deposits, limiting these to something like a hundred dollars a month, and making every agent on the system a depositary of the fund.

The street railroad systems in the large cities, together with a few of the larger interurban systems, have recently begun to adopt systematic methods of keeping in touch with their employees. The Brooklyn Rapid Transit Company, operating a great system in a part of metropolitan New York, and employing more than 15,000 men, was a pioneer in this work. It found that while the railroad Y. M. C. A. was efficient for the club-house work on steam railroads, there were local conditions in Brooklyn that made it best for the company to build and operate its own club-houses.

The first of these was remodelled from an old car-barn. It became a very interesting club, with reading-rooms, baths, a barber-shop, a gymnasium, class-rooms for evening study, and a theatre, seating some 1,200 folk. For the theatre the railroad hires vaudeville actors, and gives its great semi-official family free entertainments — followed by dancing and refreshments. On very especial nights the talent is furnished entirely by the trolley-men and very effective talent it is, too. On all nights the music is furnished by the Brooklyn Rapid Transit band, made up entirely of street-car men and men from the elevated roads of the system. The railroad company has

furnished the music, the uniforms, the instruments, and the directors — all that the men have had to furnish is their time and interest, and these they have furnished in such good measure that there is a waiting-list now large enough to equip a second full brass band.

The Brooklyn system has also begun to establish model restaurants in its outlying barns, where clean and good food is furnished to the men at cost. The street railroad is, in some such cases as these, confronted with a steam railroad problem. Many of the big car-barns are in sparsely settled suburbs of the city where the only eating-places have been saloons or their adjuncts. The street railroad can no more afford to have its men in saloons, than its bigger brother. To take from them the one decent excuse for being in such places it is establishing its restaurants, where the men can have cleaner and better food than in the saloons, and without the risk to the railroad.

The Brooklyn road and the other large systems have adopted the relief and pension funds; the idea seems to spread as rapidly among the electric as it did among the steam railroads. Some of them have added odd and efficient "kinks" of their own. For instance, the Boston Elevated Railway makes presents of gold at New Year's Day, ranging from $20 to $35 each, to each of its men who has a clean record for courtesy to patrons, and Boston gains a reputation through that for the uniform courtesy of her trolley-men. The Boston Elevated has also inaugurated a policy of giving free legal advice to each of its employees who may need it. It has always been a perquisite of high railroad officers to avail themselves of the road's legal department for their personal needs. Under the Boston plan this perquisite is extended to every man on the road — the young motorman who had foolishly gone to a loan shark, and who is now being harried by him; the old conductor who wishes to convey a house or draw a will. The road's legal depart-

ment will advise him sincerely, in his own best interest. It will draw up his legal papers, do anything for him except take his case into court, and even then it will advise an honest and capable attorney for him. As for that motorman who went to the loan shark when he found an immediate need of fifty dollars, the road stands ready to advance him the money upon good cause, and will charge him only a nominal rate of interest until it has gradually repaid itself from his wages. His division superintendent is empowered to hear his story with sympathetic ear, and to arrange for the loan.

Employees' magazines have been decided factors in both bringing and keeping the railroad in touch with its army of men. The Erie was a pioneer in this work five years ago; the plan has since been adopted with signal success by the Northwestern, the Illinois Central, the Santa Fe, the Pere Marquette, and some other lines. These little magazines, made interesting enough in a general way to catch and hold the attention of their readers, are sent out each month to every man on the system with his pay-check.

They spread railroad interest and railroad enthusiasm among their readers. On one page they tell of styles for the engineer's wife, and on the next they show an economical use of coal for the engineer; and so they may help to pay their way. They tell of errors and mistakes among the railroad's employees, without mentioning names, so that men may profit by them and act differently. But they print the names of the railroaders who do the good things, the novel things, the practical things, the economical things, the heroic things, out along the line. And this roll of honor is a long one.

But it is not always in the big things that a railroad keeps in touch with its men, sometimes it is in very small things. Some time ago, a division superintendent on the Erie Railroad decided that for each of his engineers who kept his engine in particularly good order for a given

length of time, he would have the number plate on the front of the boiler painted in red. "We will have the Order of the Red Spot," laughed Superintendent Parsons, of the Susquehanna Division, as he signed a bulletin announcing the thing. Now that was a little thing. The cost of painting that red spot on the breast of some proud locomotive was but nominal; but listen to the result!

A big Erie officer was up the line a few months later, and was loafing in a junction-town on the Susquehanna Division, waiting for a through train. He walked down to the end of the station platform and there stood a passenger locomotive waiting to take a train in the other direction. It belonged to the proud Order of the Red Spot, an order of which this particular officer had not heard; and the engineer was already about it with his long-handled oil-can. The officer did not reveal his identity, but said:

"Waiting to take out a special?"

The engineer did not look up, but said:

"We carry forty-six over the division."

"I didn't think that forty-six was due for two hours yet," said the railroad officer.

"She is not," answered the engineer, "but I've been down here an hour and a half already fussing with this baby to have her in shape. You may notice that she belongs to the Order of the Red Spot."

Then that particular man came to know about the Red Spots. All the way back to Jersey City he kept looking for Red Spots, and every time he saw one, he saw an engine slick and clean, as if she had just come from the shops. That set him to thinking; and after he was done thinking, Parsons was promoted in service, and the Order of the Red Spot was established for the system. There has been an exalted division made of that order recently. When a man can be assigned to one engine and he brings her into the Red-Spot class and keeps her there, the railroad dedicates that engine to him for the rest of his life-

time upon the system. His name, in gilt letters, goes upon the cab-panel of the engine, whereas in other days you used to see those of statesmen and of railroad-owners; and there it stays until the engine goes to the scrap-heap. The other day the first of these engines, drawing a Waldwick local, pulled into the Jersey City passenger terminal; on its cab was "Harvey Springstead" so large and clear that you could read it across the yard; in the cab-window was Harvey Springstead, prouder for that moment than any earthly prince or potentate.

Sometimes the competitive idea is the best to foster to accomplish results from the men, and to bind them and the road a bit closer together. We have seen how a fortnight of "T. B. M. F." repairs to a locomotive has been quickened down under contest to 13 hours and 34 minutes. Many of the more successful railroads began some years ago to institute annual contests between their section-bosses. The section-boss who kept his stretch of the right-of-way in cleanest, trimmest shape for a twelvemonth got a black and gold sign at his hand-car house, so big that folk who rode in the fast expresses could read the honor that it conferred upon him. Sometimes he gets more — a trip pass for his wife and himself to some distant point, or even a cash prize. Annually the superintendent of maintenance may run a special train, with a specially devised observation grandstand at its rear or pushed ahead of the engine. On that grandstand sit all the section bosses and other track maintenance experts. They see the other fellow's sections — and their own; and some time on that trip there is a little dinner and the awarding of the prizes.

Do not even dare to think that these things count for little upon the railroad. They are mighty factors in the maintenance of one of its very greatest factors, the human one.

CHAPTER XXVII

THE COMING OF ELECTRICITY

ELECTRIC STREET CARS — SUBURBAN CARS — ELECTRIC THIRD-RAIL FROM UTICA TO SYRACUSE — SOME RAILROADS PARTIALLY ADOPT ELECTRIC POWER — THE BENEFIT OF ELECTRIC POWER IN TUNNELS — ALSO AT TERMINAL STATIONS — CONDITIONS WHICH MAKE ELECTRIC TRACTION PRACTICAL AND ECONOMICAL — HOPEFUL OUTLOOK FOR ELECTRIC TRACTION — THE MONORAIL AND THE GYROSCOPE CAR, INVENTED BY LOUIS BRENNAN — A SIMILAR INVENTION BY AUGUST SCHERL.

IT is barely more than a quarter of a century since electricity first became practical for use as a motive power upon railroads. The early experiments of Thomas A. Edison at Menlo Park, N. J., and upon the now abandoned railroad up Mount McGregor, N. Y., soon gave way to real electric street railroads in Montgomery, Ala., in Richmond, Va., and from Brooklyn to Jamaica, N. Y. These, in turn, gave way to still better forms of electric traction, until the trolley has not only all but entirely driven the horse-car and the cable-car from city streets, but has performed a notable new transportation function in giving quick communication from one town to another in the well-settled portions of the country. These enterprises are quite outside of the province of this book; the cases where the electric locomotive and electric motor-car have usurped the steam locomotive upon its own rails are pertinent.

As soon as the electric railroad had begun to reach out into the country from the sharp confines of the towns, the steam railroad men began to take interest. It would have been even better for them if some of them had taken sharper interest at the beginning. But the few men who were long-sighted enough a dozen years ago to see the

development possibilities of a form of traction that was comparatively inexpensive to install and to operate have been repaid for their sagacity. These men began a dozen years ago to wonder if electricity could not be brought to the service of the long-established steam railroad.

In most cases the short suburban steam roads outside of large cities, which were as apt to be operated by "dummy engines" as by standard locomotives, were the first to be electrified, and in these cases they usually became extensions of the then novel trolley lines. Folk no longer had to come in upon a poky little "dummy train" of uncertain schedule and decidedly uncertain habits, and then transfer at the edge of the crowded portion of the city to horse-cars. They could go flying from outer country to the heart of the town in half an hour, and upon frequent schedule, and the business of building and booming suburbs was born. After these roads had been developed, other steam lines began to study the situation. A little steam road that had wandered off into the hills of Columbia County from Hudson, N. Y., and had led a precarious existence, extended its rails a few more miles and became the third-rail electric line from Albany to Hudson, and a powerful competitor for passenger traffic of a large trunk-line railroad. The New York, New Haven, & Hartford found the electric third-rail of good service between two adjacent Connecticut cities, Hartford and New Britain; the overhead trolley a good substitute for the locomotive on a small branch that ran a few miles north from Stamford, Conn.

But the problems of electric traction for regular railroads were somewhat complicated, and the big steam roads rather avoided them until they were forced upon their attention. The interurban roads had spread too rapidly in many, many cases, where they were made the opportunities for such precarious financing as once distinguished the history of steam roads — and they had in most of these cases made havoc with thickly settled stretches of

branch lines and main lines. In a great many cases the steam roads have had to dig deep into their pockets and buy at good stiff prices the very roads the building of which they might have anticipated with just a little forethought.

The New York Central & Hudson River took such forethought after some of its profitable branches in western New York had been paralleled by high-speed trolleys, and a very few years ago installed the electric third-rail on its West Shore property from Utica to Syracuse, 44 miles. The West Shore is one of the great tragedies in American railroading. Built in the early eighties from Weehawken (opposite New York City) to Buffalo, it had apparently no greater object than to parallel closely the New York Central and to attempt to take away from the older road some of the fine business it had held for many years. After bitter rate-war, the New York Central, with all the resources and the ability of the Vanderbilts behind it, won decisively, and bought its new rival for a song. But a property so closely paralleling its own tracks has been practically useless to it all the way from Albany to Buffalo, save as a relief line for the overflow of through freight.

So the West Shore tracks for high-class high-speed through electric service from Utica to Syracuse was a happy thought. Under steam conditions only two passenger trains were run over that somewhat moribund property in each direction daily, while the two trains of sleeping-cars passing over the tracks at night were of practically no use to the residents of those two cities. Under electric conditions, there is a fast limited service of third-rail cars or trains, leaving each terminal hourly; making but two stops and the run of over 44 miles in an hour and twenty minutes. There is also high-speed local service, and the line has become immensely popular. By laying stretches of third and fourth tracks at various

GH-SPEED ELECTRIC LOCOMOTIVE ON THE PENNSYLVANIA
NG A THROUGH TRAIN OUT OF THE TUNNEL UNDERNEATH
HUDSON RIVER AND INTO THE NEW YORK CITY TERMINAL

-SPEED DIRECT-CURRENT LOCOMOTIVE BUILT BY THE WESTING-
E COMPANY FOR THE TERMINAL SERVICE OF THE PENNSYL-
VANIA RAILROAD, IN NEW YORK

TWO TRIPLE-PHASE LOCOMOTIVES OF THE GREAT NORTHERN RAILWAY HELPING A DOUBLE-HEADER STEAM TRAIN UP THE GRADE INTO THE CASCADE TUNNEL

THE OUTER SHELL OF THE NEW HAVEN'S FREIGHT LOCOMOTIVE REMOVED, SHOWING THE WORKING PARTS OF THE MACHINE

points, the movement of the New York Central's overflow through freight has not been seriously incommoded. The electric passenger service is not operated by the New York Central, but by the Oneida Railways Company, in which the controlling interests of the steam road have large blocks of stock.

Similarly, the Erie Railroad disposed of a decaying branch of its system, running from North Tonawanda to Lockport, to the Buffalo street railroad system, although reserving for itself the freight traffic in and out of Lockport. The Buffalo road installed the overhead trolley system, and now operates an efficient and profitable trolley service upon that branch.

Perhaps it was because the Erie saw the application of these ideas, and decided that it was better to take its own profits from electric passenger service than to rent its branches again to an outside company; and perhaps because it also foresaw the coming electrification of its network of suburban lines around New York, and wished to test electric traction to its own satisfaction; but five years ago it changed the suburban service of its lines from the south up into Rochester from steam to electric.

It is now preparing to continue this work further. The Pennsylvania, while its great new station in New York was still a matter of engineer's blue prints, began practical experiments with electric traction in the flat southern portion of New Jersey. It owned a section of line ideally situated in every respect for such experiments, its original and rather indirect route from Camden to Atlantic City, which had since been more or less superseded by a shorter "air line" route. The third-rail was installed, and the new line became at once popular for suburban traffic in and out of Philadelphia and for the great press of local traffic between Philadelphia and Atlantic City. Of the success of that move on the part of the Pennsylvania there has never been the slightest question. Regular trains have

been operated for several years over this route at 60 miles an hour, and not the slightest difficulty has been found in maintaining the schedules.

But nowhere has the substitution of electric locomotive for the steam worked greater comfort for the railroad passenger — to say nothing of the raising of that somewhat intangible factor of safety — than in long tunnels. The Baltimore & Ohio, which was a pioneer among the steam railroads in the use of electric locomotives, began to use them in 1896 in its great tunnel that pierces the very foundations of the city of Baltimore. That system, once adopted, became permanent. What was at one time a fearful summer experience between Camden Station and Mount Royal Station in that city has become merely a pleasant novelty upon the trip.

What could be done at Baltimore has been done under the Detroit River, twice. The Grand Trunk pierced underneath that stream in 1890, by a single-track tunnel 6,000 feet in length, in which for seventeen years both freight and passenger trains were hauled by special locomotives, fitted for the burning of anthracite coal. Although these engines rendered rather satisfactory service, it was found desirable to substitute electric locomotives for them in order to remove the limitations of haulage capacity in the tunnel; for it is a known fact that electric trains can be operated much more rapidly and also more closely together than steam. The change obviated the danger and inconvenience due to locomotive gases in the tunnel. The electric locomotives first went into service in February, 1908. The tunnel is now clean, well-lighted, and safe to work in; and trains of much greater length than before can be hauled, thus relieving the congestion in the freight-yards on both sides of the river.

Similarly, electric locomotives have become the tractive power in the great new tunnel which the Michigan Central has just completed across the Detroit River at Detroit, and upon the Cascade Tunnel where the Great

Northern Railroad pierces one of the great ranges of the Western Divide. The Cascade Tunnel is interesting from the fact that it is entirely built upon a heavy grade of 1.7 per cent for its length of more than three miles. The steam locomotives are cut out from the service, while on the heavy up-grade of the tunnels an electric locomotive, of tremendous pulling power, will carry even the heaviest freights through the bore at an average speed of fifteen miles an hour. These Cascade Tunnel locomotives are the only ones in the country taking alternating current at triple phase and at the tremendous voltage of 6,600 directly from an overhead trolley wire. And that will bring us in a moment to another consideration of this question of the development and the delivery of power.

The most recent of tunnel installations has just been completed in the greatest of all American mountain bores — the Hoosac Tunnel. This famous tube, four and three-quarters miles in length, gave itself very readily to the skill of the electric engineer, with the result that the Boston & Maine system, its present owner, finds the greatest impediment to the operation of its main line from Boston to the west entirely removed.

The earlier installations were all what is known as direct current; that is, the power is brought directly from the dynamos in the power-houses and by means of third-rail or overhead trolley it is delivered to the motors of the locomotives of the cars. But some years ago the larger of the distinctively electric railroads found that for great current demands over a large distributing district, this system was expensive and impracticable; that, for the chief thing, it required copper cables for carrying long-distance current so large as to be of very great cost. So some of these, with the aid of the electrical manufacturers, experimented and developed the alternating current of high voltage and low amperage, which is capable of being carried to distant transforming or sub-stations and there reduced to low voltage and high amperage. This alter-

nating current system, because of its great operating economies, is rapidly becoming the standard for the city railroad systems of metropolitan communities, as well as for the great trunk-line interurban electric roads that are beginning to gridiron the country. The New Haven Railroad, when it first began to electrify its extensive suburban service into New York City, was the first to bring it to the service of a standard steam road, and by a clever adaptation of its locomotives was able to bring a single-phase alternating-current directly to them at the enormously high voltage of 11,000, without the use of transforming stations or direct-current transmission. After some fearfully disappointing experiments at the outset, the New Haven system has finally proved the worth of its alternating-current, and the road is now engaged in erecting its overhead transmission construction all the way from Stamford (the present terminal of the electrical service) to New Haven, 72 miles distant from New York. Within ten years its heavy New York and Boston traffic will probably be entirely handled by electricity, and the run of 232 miles will be made without difficulty in four hours or even less.

At present the steam locomotives of these trains and the other trains that serve almost all of New England are detached from the inbound movement at Stamford, and the remaining 33 miles of the run into the Grand Central Station is made behind a powerful electric locomotive. The process is, of course, reversed on outbound trains. For the 12 miles from Woodlawn into the Grand Central the run is made over the tracks of the Harlem division of the New York Central Railroad which uses direct current at a voltage of 650, and third-rail instead of overhead transmission. The wonderful adaptability of the alternating current is shown, not in the fact that a change must be made from overhead trolley to third-rail alone, for that is merely a slight mechanical problem, but in the fact that a locomotive hauling a heavy train can, without a great

slacking of speed, change from receiving an alternating current of 11,000 volts to a direct current of 650 volts. Outbound, it reverses the process.

The necessity of clearing out the smoke-filled Park Avenue Tunnel approach to the Grand Central Station brought both the New York Central, its owner, and the New Haven, its tenant, to electric traction for terminal and suburban service at New York. The New York Central's system, as has already been stated, is direct-current and it is supplied from two great power-houses in the suburban district. Through trains are hauled in and out of the station by electric locomotives, while suburban trains, which make their round-trip runs entirely within the 25 or 30 miles of electric zone, are run without locomotives, the steel suburban coaches having motors set within their trucks, after the ordinary fashion of electric cars across the land. The change from steam to electricity at the Grand Central Station did more, however, than merely clear the long-approach tunnel of smoke and foul gases, so that nowadays a man can ride on the observation-platform over its entire length. The traffic in that wonderfully busy station has for many years had sharp limitations because of the four tracks in that tunnel, two tracks being used for the train movement in each direction. The limited station-yard capacity at the terminal has necessitated many trains being stored at Mott Haven yards; and the drilling of these empty trains in and out of the station, combined with the normally heavy movement of regular and special trains, has only added to the great congestion. The minimum three-minute headway between trains operated by steam through the tunnel, and its four-tracked viaduct approach, fixed the maximum traffic at 40 trains an hour in each direction. The capacity of the terminal with this limitation of service was taxed to its utmost, and some relief for the constantly increasing traffic was imperative. Now, owing to the improved conditions of electric operation, trains may be run on a two-minute headway,

or less — this one measure thus increasing the station capacity by 50 per cent at the least.

The New Haven road has also adopted the practice of running some of its suburban trains without locomotives, but by means of motors underneath each coach — the multiple-unit system, as electrical engineers have come to know it. This is the system, with some slight variations, upon which the elevated and subway lines of New York, Brooklyn, Boston, Philadelphia, and Chicago are operated; and it is quickly applicable, as we have just seen, to some phases of terminal operation for the standard steam railroads. But the steam locomotive is to hold its own for many years, in many, many phases of railroad operation; electric traction is practical and economical only when there are fairly congested traffic conditions. The coaches that are standard for it, and which it must haul for many miles across the land, must be handled in the electrically equipped terminals by electric locomotives of one type or another. These locomotives are generally equipped with coal-heaters for maintaining the steam in the heating-pipes of the through equipment; and in these days, when the electric lighting of through trains is all but universal, they may supply current for this purpose also.

Electric locomotives have been completely successful where they have been used, both alone and in connection with multiple-unit suburban trains, in the Grand Central Station and the Pennsylvania Station in New York City as the first complete installations. But what has been so successfully done in New York will soon be repeated in other big cities in the land; Boston is already insisting that the network of suburban lines that spreads over her environs be electrified; Philadelphia is preparing for the electrification of the Pennsylvania's fan-work of lines into Broad Street Station; Baltimore is demanding that what has been done in one great tunnel underneath her foundation hills be repeated in two others. Chicago will see great installations of this service within the next few years.

or is the use of electricity upon the standard steam
oad to stop bluntly with these terminal changes and
ovements; many and many a decaying branch is yet to
nned into new life, new strength, new activity, through
lful transformation of its tractive powers. What has
done at the Detroit River and the Cascade tunnels
be done elsewhere across the land — through the
ns of points where railroads pierce the mountains
go under the rivers by tunnels. Electric tunnels are
o bring the Pennsylvania at lower grade at Gallitzin
the Southern Pacific through the high crest of the
as. Electric traction for the big steam roads is still
infancy. Only 1,000 miles out of a total of 220,-
niles of steam railroad in the land are as yet operated
ectricity. The other day a big traffic-man sat in his
igo office and said:
The first railroad that electrifies for the thousand or
niles between this town and New York is going to
ll the rich passenger business. Not a big portion
mind you, but every single blessed bit of it!"

nsider for a final moment, in passing, the mono-rail,
yroscope. If you are a practical railroader you may
i and say: "A toy." Perhaps it is a toy to-day. But
remember history and you will recall that the toy of
y becomes the tool of to-morrow, and then give the
o-rail a moment of sober thought. Less than 2,000
of this construction formed a most interesting exhibit
e Jamestown Exposition of 1907. A railroad man
rode on that experimental track said:
If you had built more than 300 feet of track you
I have given a better demonstration of your system."
his the inventor smilingly replied:
You have gone over 1,800 feet."
ie investigator had ridden faster than 45 miles an
and had not realized the speed. You never do in
iono-rail car. It rides more gently over the roughest

bit of track than the finest Limited moves over heavy rail and stone ballast, the best track that men can maintain.

An actual railroad of the mono-rail type has been built and is being developed in the suburbs of New York City. It supersedes a railroad of the oldest type — horse-cars — from Bartow to City Island, in the Bronx. Balance is kept for its cars by means of a light overhead metal construction, hardly more conspicuous than that of the overhead trolley-work used in city streets. This overhead work, like the trolley-wire, supplies electric power to the cars; only in emergencies will it come into play to hold the one-legged car erect. On this stretch of line speed and balance tests will be made when passenger traffic is at low-tide. Upon the result of these tests will be drawn the construction plans for a four-track rapid transit railroad from New York to Newark, ten miles. This last plan has already been financed by New York men who have made transportation their chief problem for many years. It may be developed upon the rails of a double-track railroad, more than doubling its capacity, without increasing the width of the right-of-way.

All of these mono-rail roads will become applicable to the gyroscope when that wondrous man-toy becomes a man-tool. And the gyroscope demands no overhead construction of any sort. It simply asks a single rail upon which to find a path and offers no objections either to the steepest of grades or to the sharpest of curves. The first model of gyroscope car showed its ability to navigate easily the full length of a piece of crooked gas-pipe, laid in rough semblance of a track.

For there is a gyroscope car already — in fact, several of them. On May 8, 1907, Louis Brennan, a brilliant Irish inventor, living in England, exhibited the first model of the gyroscope car, and the news was flashed in detail all the way around the world. The little car he then showed was enough to interest the keenest of scientists. It

aversed every sort of mono-rail track that could be de-
sed, at varying rates of speed, it stood still at the in-
ntor's command and retained its balance perfectly.
hen a man's hand was pushed against it as if to throw
e car off its seemingly slight balance, it pushed back,
anchly held that balance, and Brennan laughingly said
at there was something that compared with the velocity
the wind. When he spoiled the even trim of his ship
t did look like a boat as it sped around the lawn upon
narrow, guiding thread) and placed the weights upon
e side of the car, that side rose up to receive them. The
r still held its balance perfectly, and Brennan said that
s act represented forty or fifty persons moving suddenly
ross a full-sized passenger coach. Finally, he placed his
tle daughter in the car and sent it out over a deep gully
here a single stout steel cable served as a suspension bridge.
he inventor's assistant swung that bridge like a hammock
ut the car laughed at the old-fashioned domineering laws
f gravity, and the little girl waved her hand at her daddy.

Well might she wave her hand at him. His achieve-
ent was a real triumph. From a top revolving in a
ame at any angle he had evolved the gyroscope car, the
ne thing required for the successful development of the
ono-rail. From that car he has been steadily devel-
ping better ones. On the tenth of November, 1909, he
uilt a full-sized car upon which twenty men and boys
de in glee. On that self-same day, by strange coin-
dence, a German inventor, August Scherl, exhibited in
large hall in Dresden, a mono-rail car, held at perfect
quilibrium by a gyroscope which he had quietly built and
erfected. The car was 18 feet long and 4 feet wide,
nd mounted on two trucks. The net weight was 2½
ons, while the gyroscope itself, turning in a vacuum at
he fearful rate of 8,000 revolutions a minute, weighed
ut 5½ per cent of the total weight of the car. It carried
ight persons, and when first shown in Berlin it caused a

tremendous sensation, 60,000 persons witnessing the trial during a period of five days. Even royalty took its turn at riding in the novel conveyance.

The first question that the average man asks when he sees a gyroscope is:

"Well, this thing may be all right when it is in motion, but how the deuce is it going to support itself when it is standing still?"

But it does support itself. The gyroscope wheels continue to revolve at something close to 8,000 revolutions a minute, and they hold the car, so that the fluctuation in the weight it carries, due to loading or unloading, does not affect it, even in slight degree. The average man remains unconvinced.

"Suppose the electric power that spins the gyroscope goes back on you?" he demands. The inventor tells him that that is easy enough. The gyroscope, revolving in a vacuum, will keep on turning at sufficient speed to balance the car for nearly an hour. Long before that the side-stays, that make the car a three-pronged structure while out of service, can be dropped.

When To-morrow finally comes and the gyroscope car is in its own, provision will be made on all through mono-rail routes against just such an emergency. At various points sidings will be constructed with low walls, just high enough to receive the cars when their gyroscope equilibrium ceases. These will be just as much a part of the equipment of the mono-rail trunk line as wharves are a part of steamship service. It will be a part that will receive less and less attention as folk begin to realize how little dependent the gyroscope car is upon the old laws of gravity.

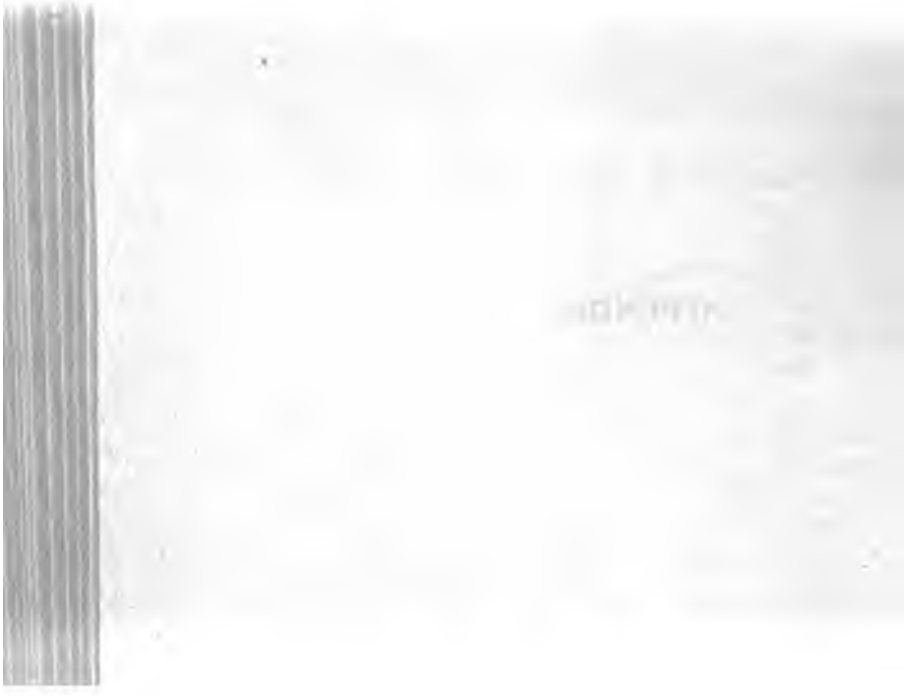
"We will have billiard cars in our fastest trains," says Brennan. "A man will be able to play that delicate game on a railroad train all the way from New York to San Francisco, if he chooses."

ontemplate that, you railroaders and travelled folk
›-day. Those cars will make the cars of to-day seem
pygmies. Each will be 200 feet in length and 30
in width. No wonder that people can talk of bil-
l tables. A train of six of these cars will be longer
the longest of our transcontinental expresses of to-day.
y will be fastened together with vestibule connections,
the forward end of the first car will have a sharp
:. The blunt front of an ordinary train begins to be
eed obstacle at more than 50 miles an hour.
›eed? Do you think that 50 miles an hour is speed?
locomotives do far better than that every day in
United States. A train on a standard railroad and
ed by steam as a motive power has gone faster than
:ate of 135 miles an hour. With the mono-rail and the
›scope, with the countless mountain brooks and rivers
ıessed and grinding out electricity, the inventors say
ıly that they will begin at 200 miles an hour.
'o you realize what 200 miles an hour means? It
ns that your grandson or your grandson's son can
ɛ New York in the morning, do half a dozen errands
:incinnati, and be back in his home in West Four
ıdred and Thirty-eighth Street in time for a late sup-

It means that he can lunch in Chicago, span half a
:n mighty States, threading the mountains, through
:owns and over the cities, skimming the broad expanses
at farms, and dine in New York the same night. It
ns that he can go from one ocean across the continent
ıe other in twenty-four hours.
ut To-morrow is not yet here. Yesterday was just
. In Yesterday men were boasting of their ability
o from New York to Philadelphia by coach in two
ts and two days and were asking:
What next?"

APPENDIX

APPENDIX



APPENDIX

EFFICIENCY THROUGH ORGANIZATION

N a local freight-house in an inland manufacturing city of thirty thousand inhabitants between forty and y freight-handlers had been employed for a term run- ig from twelve to fifteen years. The freight-house ss was of the old school. When he thought that he eded more help, he made a fearful noise, scared head- arters, and more help was given him. The strong- ned gang reported at seven o'clock in the morning and n held a two-hour *conversazione,* while the book- ping force in the dingy office at the end of the freight- d arranged the way-bills and the bills-of-lading for day's work. Before ten o'clock, if all went well, the ight-house gang was generally at work pushing its way ough a seeming chaos of less-than-carload freight.

After a time the old freight-agent died and a new one me in his place. The new man was on his job less n three months before he arranged a new schedule that freight-house — and dropped twenty-five men m its pay-roll. First he summoned the bookkeeping ce together, and announced that it would report at e o'clock in the morning, instead of seven; of course, ving two hours earlier each afternoon. The book- eping force demurred. It was not pleasant getting up fore daybreak in the winter darkness of a chill northern wn, and such a scheme interfered with the social plans one or two of the bookkeepers. But the new boss ly smiled and said, "Try it."

And after they had tried it, the way-bills and the bills-

g were ready at seven o'clock when the handlers reported for work, and the freight-house got to work upon the shriek of the roundhouse whistle. After that, the pay-list was cut — you may be sure that a house-boss who could scheme out such a plan could weed out the shirkers and the idlers among his staff — and, better still, the consignees began to get their freight sooner than ever before in the history of that town.

Eventually — and a wonderfully short "eventually" it really was — the freight-agent climbed the ladder to the superintendent of that division and under his bailiwick came a railroad which had recently become attached to the parent system through the process of benevolent assimilation. The ordinary less-than-carload business was moved out of the freight-house of the smaller road and it was given over entirely to carriage and automobile shipments — the inland city makes a specialty of manufacturing vehicles of every sort. The division superintendent went over to the carriage freight-house and saw that it took a dozen men to man it, although it was not more than a six-car stand. Carriage bodies and automobile bodies crated are both heavy and awkward, and the boss of that house was asking for more help.

The superintendent went straight from that freight-house to a local foundry, sat there for fifteen minutes with its draughtsman and then and there evolved an overhead trolley-arrangement, very much the same as the big packing-houses use for handling heavy carcasses. A requisition for the thing went through a-flying, and now the carriage-house in that city is handled with two trained men. The scheme is fast becoming standard in the newer freight-houses and in St. Louis, the M. K. & T. has just adopted it for its splendid new terminal, whole fleets of platforms hung close to the floor and suspended from an overhead "trolley arrangement" entirely supersede the brigades of hand trucks formerly in use.

That is the point of it. There must be dozens of other cities of thirty thousand population, of sixty thousand, of ninety, of one or two or three, of five hundred thousand, where a little such method would produce similar results. In that first house, a saving of about $350 a week was made, when the young freight-agent brought some system into the dusty place. A dozen such savings or even greater, would be quite a help on the railroad's balance sheet. At least that is the gospel which Louis Brandeis, of Boston, preached, and which attracted world-wide attention when he made the exact statement that he could save the railroads of the country a million dollars a day in the operation of their lines.

The railroads made a perfectly good legal case before the Interstate Commerce Commission — or let us assume that, at any rate, in the present instance. But one such clarifying statement as that of Brandeis' produced more effect both upon the land and the Commissioners than all the legal briefs that together were filed in advocacy of the raises in the freight tariffs. At no time did the railroads successfully controvert Brandeis' sweeping statement, and so they lost their fight.

And yet the railroads are accomplishing some remarkable improvements in their internal affairs — for which they are being given not an iota of credit. And one of the most interesting of these is the promotion of efficiency through organization, or better yet, through reorganization.

Along in the fifties, Herman Haupt, who was afterwards a brigadier-general of the United States army and brevetted major-general, devised the wonderful organization scheme of the Pennsylvania system, which is still in use to-day on that well-managed property. The scheme has been adopted since then by practically all the large railroads in the country. Before General Haupt evolved it, there was no real organization among the

great railroads. Like Topsy, they "just growed" from the little individual horse and steam lines from which they were formed and they were even more like Topsy in some other details. But Haupt's plan brought dignity to a great business that needed dignity — and system. For fifty years it has been accomplishing something more than merely serving its purpose. But railroad terminals and railroad equipment of fifty years ago are long since obsolete, and so within recent years the larger railroads have found their organization schemes not up with the times. The growing complexity of their work, the intricacy of their relations with the various city, state, and national governing boards, the constant tendency to enlarge and to consolidate these, have all proved fearful taxes upon the Haupt plan. Great masses of correspondence have accumulated, the whole business of conducting the railroad has been enmeshed in whole miles of red-tape — and men like Brandeis, of Boston, have been permitted to make their challenges and stand uncorrected.

Go back into the sixties for this last time, and pause for a moment at the fighting of the American Rebellion. Men in the North were beginning to hear that the Confederate army had something different, something better, in its organization than the Union army. It was an intangible something, but it seemed to make for efficiency, and, after all, that was the main thing. So after the war was history, there were far-sighted Northerners who said that it would be well to bring that intangible something into the United States army. At such a time that thing was, however, tacitly impossible, and it was dropped for more than thirty years.

But Von Moltke picked up the idea, and incorporated it in the intensely modern army of modern Germany. It helped to win the great Franco-Prussian War, and when the other nations of Europe began to examine it it had a name; it was beginning to be a tangible something. Military men called it the "staff idea," and when you

asked them to explain it they told you that officers who handled men were known as "line officers," and those who handled things as "staff officers." In other words, men could be lifted — as it were, in an aëroplane of scientific organization — away from their commands and their narrow environments, up to a point where they could have perspective, where they could handle men, regiments, small arms, heavy ordnance on a large scale. The staff officers work in things in the abstract, just as the line officers mould men in the concrete.

There then is the rough theory of staff organization which was picked up and adapted to its use by the United States army at about the time of the Spanish-American War. Of its value there can be no doubt; of its efficiency no question.

A young man — Major Charles Hine — who had seen the operation of modern staff in the regular army, decided that it was a good thing for the great railroad systems of the country. Hine knew railroads. In order that he might know them thoroughly, he one day packed his uniforms and his saddle away in his trunk and went quietly out and got a job as brakeman on a freight train. He did not stay on the car roofs very long; he has served in about every conceivable post in railroad divisional organization, and he has had a good chance to study the weaknesses of those very organizations.

"We have got to eliminate government by chief clerks," said Major Hine at the very beginning. "We are growing too rapidly for the men higher up. We are forced to delegate official authority to clerks and foremen, and then we build up an autocracy around some person of official rank. It is pernicious feudalism, this permitting the chief clerk, and a good many times some other clerks, to sign the name of the officer whom they attempt to represent."

A railroad is really so spread out that its officers live

a double official life; a part of the time they are at their desks, and another part out upon the line. Yet the average railroad officer, be he of high or low degree, flatters himself that by some subtle method of personal superiority, he is enabled to act intelligently in two places at the same time.

Major Hine saw how that worked at the very beginning of a special service with the Southern Pacific Railroad. He was down in the Yaqui River country in Mexico, where heavy construction work was under way. In company with the division engineer, he was riding the line mule-back. The division engineer had several parties under him, each in charge of a resident engineer, and all engaged in laying out and checking the contractor's work. The headquarters of the division engineer were presided over by a ninety-dollar-a-month chief clerk, who was dealing in the absence of his superior with one hundred and twenty-five dollar resident engineers. The division engineer assured his guest that the telephone permitted close personal contact with headquarters, that every hour questions were referred to him. The vice-president of the company, desiring to change the assembling point for luncheon, sought for two hours from engineering headquarters to locate the division engineer, who was on the grade all the time.

The condition mentioned necessitates the chief clerk's signing the name of his superior to heads of departments lower down, which heads are receiving lower salaries, and are presumably of wider experience than the chief clerk who essays to be their monitor. This is done in the name of routine business. Unfortunately no two men often agree upon what constitutes routine business. Almost every railroad officer will tell you that "my chief clerk handles only routine business and never assumes too much authority." When closely questioned, the same officer will reveal in the utmost confidence the fact that the same condition does not obtain with the chief clerk of the

is over the informant. Strangely enough, if
ining witness is promoted to his boss's job,
ondition still exists, showing that the system
rather than its individual members. Worst
chief clerk has to break in all the new bosses
as only limited promotion himself.

Hine has said that the bigness of things on
ıan lines, the breadth of the policies of Napo-
man and Von Moltke Julius Kruttschnitt, the
nt in the change of the operation of that far-
roup of railroads, strengthened his nerve to
ıdical departure from preconceived notions of
ganization. Hine, at his home in Virginia,
cted as receiver of a suburban trolley system,
ad introduced a simplified organization. He
hat time, that the underlying principle of that
n would apply to a thousand times as many
e great Harriman lines. Incidentally, after
ship was lifted, the new owners of the prop-
tinued the organization which Major Hine
l, for they took the ground that no other
d had such a system, and that therefore there
ɔthing in it.

ıitt decided to let Major Hine begin on the
lines with the reorganization of the divisions.
l to order any changes, but placed the burden
ry work and conversions among his subordi-
he shoulders of his special representative.
not a dozen letters bearing on this subject in
's office. The work was done by personal
ich in two years involved over one hundred
ıiles of travel by Hine. Major Hine states
thstanding the splendid spirit of the officers
rriman lines, little would have been accom-
hout the tactful support of Kruttschnitt, the
supremacy and whose brilliant abilities are
d in the railway world. On the other hand,

Kruttschnitt has been heard to say that the credit lies with the enthusiastic younger man whom he attached to his staff.

Most of the divisions of the Harriman lines had an assistant superintendent, engaged mainly in outside duties, with an office near the superintendent's, presided over by a chief clerk. Both the superintendent and the assistant superintendent had his own chief clerk, who consumed reams of paper annually in intercommunications over their respective superior's signatures. The new system provides, as a first step, that if the division has no assistant superintendent, one shall be appointed. The next step is to order the assistant superintendent to remain at headquarters in charge of the office, in effect, but not in name, the chief-of-staff idea, so successfully applied by the Germans through Von Moltke. When necessary, an additional trainmaster is appointed for the previous outside duties of the assistant superintendent. The old chief clerk is placed in line of promotion by appointing him, when possible, to a position with outside duties on the road.

Next, the division shop is raided, the division master mechanic and the travelling engineer (road foreman of engines) are moved bodily to the same building with the division superintendent, where are usually already located, the division engineer, the trainmaster, and the chief despatcher. The old theory has been that the master mechanic should be at his shop to supervise the shop force. The new conception is that the master mechanic has passed the stage of a shop foreman; that, located at one shop, he unconsciously comes to underestimate the importance of roundhouses and car repair plants at outlying points on the division. He is brought to division headquarters to get the atmosphere of transportation, to be in touch with the train sheet, and to realize that motive power is one of the component ele-

ments of transportation; that the shop is incident to the railroad, not the railroad to the shop.

The official family, now being gathered under the parental roof of the superintendent, are politely requested to deposit the official shooting-iron, the typewriter, in one official arsenal, from which all shooting will be done in the future. The office files are consolidated in one office of record. This idea is borrowed from the courts of justice, where one clerk of the court, with as many deputies as necessary, records all transactions regardless of the number of judges and other officers.

You must have worked in a railroad office to appreciate the fearful condition of official files in this year of grace, nineteen hundred eleven. You ask for the file on that culvert at Jones' farm on the Martinsburgh branch, and an anæmic office-boy staggers toward you with enough manuscript to be the making of a novel. There are the contract arrangements and the correspondence with the J. B. & G. concerning the union station privileges that are enjoyed with it at Blissville; why, there was a whole chapter given over to that episode of July, three summers ago, when the leaders had to be renewed on that magnificent structure, and its roof re-shingled. Here is the contract for handling milk on a single side-line division — and the accompanying symposium of thought from chief clerks and minor officers in the form of miscellaneous — and entirely useless — correspondence. This is the agreement with the bridge-builders' union — four inches thick. No wonder the shelves of the record room sag, and that the clerks are hollow-eyed. Tons of unprotected paper have been scrawled upon, perfect rivers of helpless black ink have done the work — and all for that!

The heaviest file in the office of the Harriman system to-day is half an inch in thickness, and there is no one to deny that the property is being run at a high stage of

efficiency — particularly in comparison with some other railroad systems of the land. As the result of a single record system at any division headquarters, the astounding saving has been to that group of railroads, of five hundred thousand letters a year, and it now goes without saying that they were unnecessary letters. In a year or two, that figure will cross the million mark — and you must take second breath to imagine the time and thought that goes into the making of a million letters in a twelvemonth. The material saving in stationery is considerable — although trifling in the operation of a system that spends about $225,000,000 a year, but the logical claim is made that the five hundred thousand letters eliminated retarded rather than helped administration, that they produced more harm than good. Deeper than all this is the dwarfing effect upon the individual initiative of the man below, for whom the letter attempts to think.

Elimination of red tape is not the sole object of the new system. Mr. Kruttschnitt regards this as incidental. What has appealed to him is the final step in the organization which is to confer the uniform title of "assistant superintendent" upon the former division engineer, master mechanic, trainmaster, travelling engineer, roadmaster, and chief despatcher. These officers retain their former duties and responsibilities, but they broaden authority to meet emergencies on the spot. This means increased supervision of employees, more scientific management of men. The officials of the Harriman lines faced here a ticklish problem. The attitude of organized labor was in doubt. Would the men object to too many bosses? Would confusion result from several men issuing orders that might possibly conflict? The results have been a splendid vindication of the intelligence of the men who are close to things. The men were often quicker to catch the idea than were the officers. What

appealed to them most of all was the dictum that no man could sign another man's name or initials.

"We old men do our work, no matter how many bosses there are; we realize that younger men need more instruction than supervision," said a veteran conductor on the Union Pacific, when the matter was brought to his attention. "We used to make one report to the master mechanic and another to the superintendent. Now one report addressed simply 'assistant superintendent' is enough. It means less red tape. But what we like best of all is that some smart Aleck of a clerk can no longer jack us up."

That veteran ticket-puncher recalled that in older days conductors had been dismissed for allowing operators to sign their names to telegraphic train orders; perhaps the letter of dismissal was signed by the superintendent's chief clerk. There was railroad system for you!

After a year and a half of what the local officers called trial — for Mr. Kruttschnitt and Major Hine have always regarded that period as demonstration rather than as experiment — the system was broadened. It was applied to some of the higher units. For nearly a year, the U. P. general officers at Omaha have had five assistant general managers. In other days there were a general superintendent, a superintendent of motive power, a chief engineer, a superintendent of transportation, and an assistant to the general manager. The new million dollar general office building of the U. P. at Omaha will have its office space arranged according to the new conception. Until it is completed, the consolidation of office records will not be practicable, because the various general offices are now scattered over town. But a start has been made, and plans laid for full development.

What is good at the east end of a railroad is generally as good at the west end, and so the plan, working handily in general offices at Omaha, has been transplanted to

the general offices of another Harriman road—the newly combined Oregon-Washington Railroad & Navigation Company at Portland, Ore., and at Seattle, Wash. Other general headquarters of the Harriman roads are only awaiting the construction of new and modern office buildings, before they will be asked to fall in line with the plan. Kruttschnitt does not order these things. He is far too wise a railroader for that. He directs by suggestion and the family circle talks of Major Hine. And yet twenty-three out of the thirty-three divisions of the Harriman railroad group have fallen into the new groove within two short years.

"Consider for an instant the overwhelming importance of a title to some railroaders," says a high officer of one of that group as he sits at his desk. He is one of the men to whom a title is as hollow as a brass cylinder. "I have known a man to almost froth at the mouth because some stupid underling wrote a letter and addressed him as 'assistant to the general manager' instead of 'assistant general manager.' We have gone title crazy on some of our railroads. Take that overworked word 'superintendent.' We have more superintendents on this system to-day than there used to be track hands on a good sized road, and we have what is even worse, a superintendent of motive power, and a superintendent of transportation ranking the division superintendent who is the head of an important subordinate unit, and entitled to respect among the rank and file of our men as such. Under the new plan, the superintendent of transportation together with the superintendent of motive power, as you have already seen, become assistant general managers.

"Right there is an impersonality that is delightful—and efficient; it has proved most efficient in division organization. Out on our —— division we had several washouts simultaneously last year. We sent at once an assistant superintendent to each point of interruption and

o we had at each vital place, a man with sufficient brains nd authority to use the forces on the ground to the best dvantage. Is n't that good railroading?"

It is good railroading all along the line. It is good ailroading to handle as big a question as the reorganiation of a system employing a quarter of a million men nd women, without writing a whole library of rules and egulations for its enforcement. Ask Major Hine, himelf, how he handles that problem.

"Easily enough," will be his reply to you. "We have constitution — also unwritten like that splendid old ulwark of English liberties — and any superintendent, ny general manager, can make his own rules for his ivision or his stretch of railroad as long as they will and the tests of that constitution. And the railroad's ulwark consists of but three very simple principles:

"The first of these is that no man may sign the name the initial of another. That is rank feudalism, and t of place in the twentieth century sort of railroading. ur second clause is that there must be at all times an sistant superintendent in charge of the office. Norally, this assistant, in effect chief-of-staff, is the senior No. 1 on the list. Here again, elasticity is introced. The unwritten law provides that whatever astant may be assigned to the office is the senior of the hers for the time being. The chief-of-staff reviews e incoming and outgoing correspondence and reduces to its lowest terms. Each assistant superintendent gns his own communications, but they pass through the cus of the administrative hour-glass on the desk of the tchful chief-of-staff.

"In the third place, correspondence must be addressed personally; from below, 'assistant superintendent,' om above, 'superintendent.' This requirement is based on the idea that authority, as in the courts, is abstract d impersonal, that the exercise of authority is highly

concrete and personal. The court exists if the judge is dead; the court is silent until the judge speaks."

Already there is noted a greater willingness to take responsibility. More and more is heard about "this division" and "the company" and less and less about "my department." The mathematical axiom that "the whole is greater than any of its parts" is sometimes violated in corporate administration, because there is no chief-of-staff to balance the specialization of some department head.

This system of playing trumps in the new science of railroads incidentally, but not essentially, provides for rotation in the position of senior assistant or chief-of-staff. Some conservative divisions have not availed themselves of this feature. On one division the superintendent in the first year of the new organization had four of his five assistant superintendents, each occupy the senior chair at headquarters for three months each. Finally, it came the turn of the old master mechanic.

"I am sweating blood," he said, "but I never knew before how much there is about a railroad."

When that master mechanic returned to his shop interests, his vision had been broadened, and he was more alert to protect the company's interests when riding over the road. The sponsors for the new system deny that this may lead to the neglect of an official's own special responsibility. They point to the superintendent as a balance wheel to maintain proper equilibrium. Over two years' experience has led the high officials of the Harriman lines to lay some stress upon urging the assistant superintendents forward rather than holding them back. The tendency has been to settle back in former grooves. As long as no harm is done, those who avail themselves of their new opportunities are becoming more valuable assets both for themselves and for the company.

When a division is reorganized, the persons concerned

for fifteen thousand miles — over whole sovereign States, from ocean to ocean — properties whose management calls for a degree of skill not yet demanded in the very greatest of our industrial or manufacturing corporations.

The old order changeth and giveth way to the new.

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